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A ROENTGENOLOGIC STUDY OF THE BREAST*

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WE WISH to present a simple method of studying the breast by means of stereoscopic roentgenograms. This technique has been in use for practically three years at the Strong Memorial Hospital and about 100 cases have been studied. We believe that this method will be absolutely diagnostic in some types of cases and of considerable assistance in others. It has a very definite limit in certain instances. This limitation will be described in detail. Cutler† recently described a transillumination technique for the study of pathological conditions in the breast. Transillumination of the breast is essentially similar to soft tissue roentgenograms. Roentgenograms, however, have the additional advantage of a stereoscopic technique and permanent record.

TECHNIQUE

The technique is simple. A Potter-Bucky diaphragm gives the best results, but it is not absolutely necessary. The patient is placed obliquely, say upon her right side with the right arm elevated above the head which rests upon it. The axilla and pectoral muscles are thus stretched upward and outward. The right breast should then be centered upon the Potter-Bucky diaphragm so that its greatest thickness will be silhouetted upon the film. This can be adjusted somewhat by having the patient pull upon the skin of the chest with the tips of the fingers. In patients having large breasts, the left breast is pulled back and upward out of the way by the patient (using her left hand). A sand bag is placed under the left shoulder

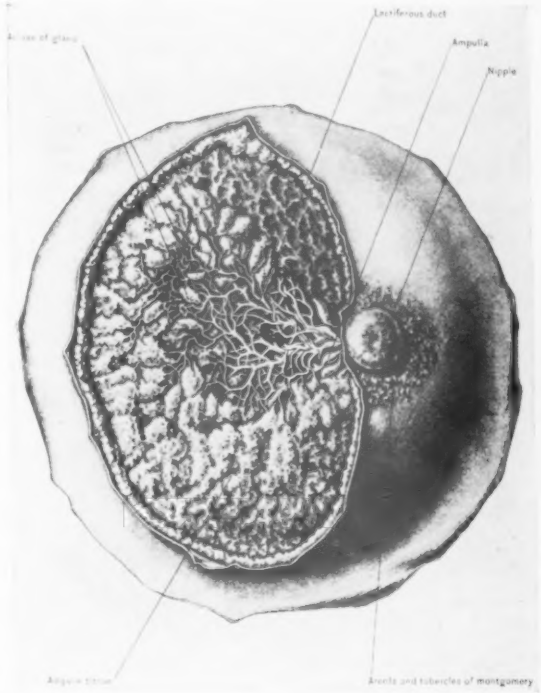

FIG. 1. Drawing of the breast showing gross details. (From Deaver and McFarland, "The Breast," Blakiston's Son & Co., 1917.)

* From the Department of Radiology, Strong Memorial Hospital, Rochester, N. Y. Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

† Cutler, M. Transillumination as aid in diagnosis of breast lesions, with special reference to its value in cases of bleeding nipple. *Surg., Gynec. & Obst.*, 1929, *48*, 721–729.

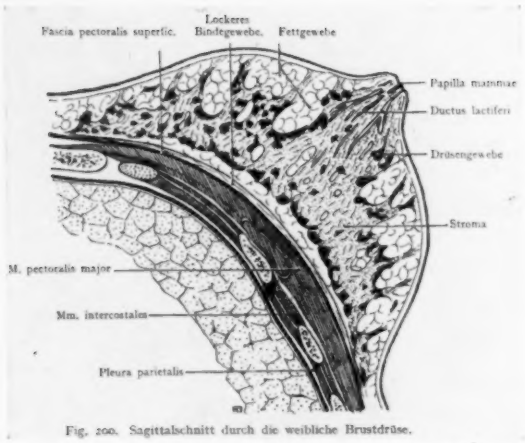

Fig. 2. Drawing from Corning's "Anatomy" showing sagittal section of the breast.

to enable the patient to retain her position.

The tube is centered over the middle of the breast or over the suspected area if it is large. A pair of stereoscopic films are made in the usual manner. The shift is usually up

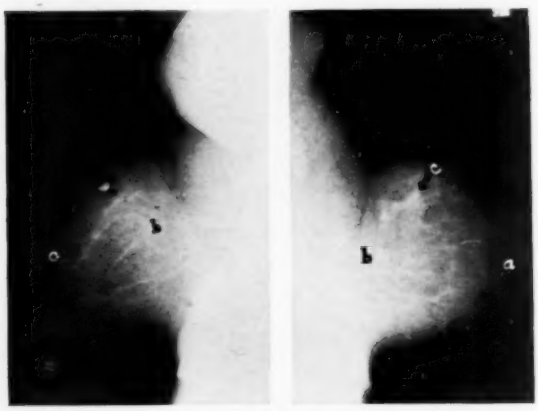

Fig. 3. Simple obesity. Note the ducts (*a*) and acini (*b*). There are several small masses due to chronic mastitis in each breast (*c*).

and down, though a cross shift is occasionally made, depending upon the type of case.

The factors are: 70 ma. and 2½ seconds, or 185 ma-sec., 25 inch target-film distance, 50 to 60 kv., double screens, 10″×12″ Eastman superspeed film, Potter-Bucky diaphragm.

The opposite side is always taken for comparative study. This is very important.

Mr. William T. Hill, our head technician, is responsible for the simplification and standardization of this technique.

Interpretation of the Normal Breast

When the films are viewed stereoscopically (preferably with both breasts shown side by side), the normal breast structures can be fairly clearly seen. The nipple usually stands out from the areola. The ducts, usually numbering from five to eight, extend downward toward the base. The base is sharply separated from the pectoralis muscles by a definite line or septum about 1 mm. in thickness. The acini masses or lobules of the breast stand out from the fatty masses which are usually transparent. The lobules frequently extend upward toward the axilla to make what is called the tail of the breast.

Fig. 4. Obese lactating breast with acute mastitis and abscesses in the outer upper quadrant of the left breast.

The pectoralis muscles are usually seen as a layer from 1 to 3 cm. thick beneath the base of the breast. There is a thin septum

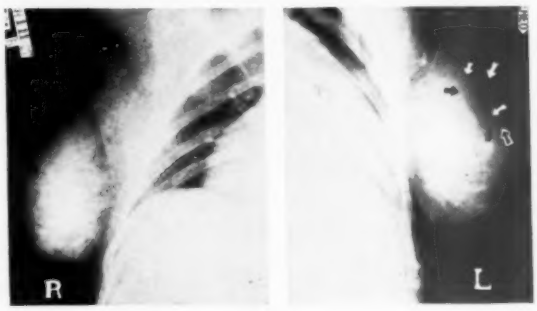

Fig. 5. Same patient as Figure 4, showing change in the left breast after incision and drainage of the abscess in the outer upper quadrant.

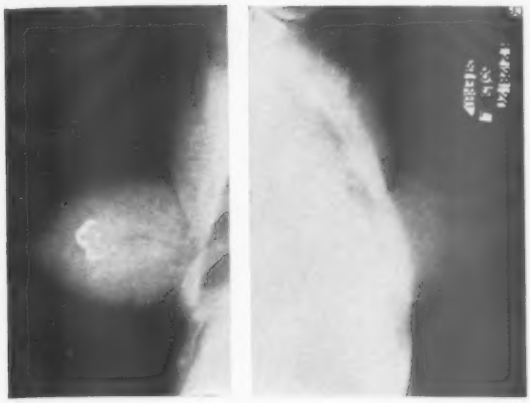

Fig. 6. Right breast showing intracanalicular myxoma with calcification in an old area of hemorrhage. Left breast: chronic mastitis. The details are difficult to see in the reproduction.

between them and the ribs and intercostal muscles. Often the pleura can be identified as a faint line.

In the axilla the nodes are not usually visible, but the blood vessels and muscles stand out clearly. The axillary hair if thick, and especially if dirty, may stand out distinctly.

This normal state varies all the way from the flat discoid breast, where the structures are very compact, to the huge obese breast where they are spread apart by the masses of fat.

CHANGES DUE TO PREGNANCY

In the fifth and sixth months of pregnancy the films show a definite enlargement of the whole breast. This involves the fatty masses and the lobules. The ducts become denser, and the breast (previously slightly flabby) seems tenser and more rounded. This process becomes more marked as time goes on. Just at term, and especially at the onset of labor, the breast is large, tense, and suffused with either edema or congested blood vessels. The appearance is not unlike chronic passive congestion of the lungs with patches of consolidation, the latter being represented by the dense, markedly enlarged breast lobules. At this stage the breast lobules become feathery at their margins.

Fig. 7. Drawing showing the clinical appearance of the breast in Figure 6.

Fig. 8. Specimen of breast in Figures 6 and 7 showing the whorl formation and the lobulation which is visible in the roentgenogram. The circumscribed area of calcification (*a*) shows some central degeneration. Intracanalicular myxoma.

After birth, and after lactation has commenced, for the first few days the breast structures are obscured by a rather diffuse haziness, and the dense lobules are indistinct in outline. At the end of a week this haziness has disappeared to a great extent.

Fig. 9. Clinical diagnosis—papillary cystadenoma. Three radium seeds are visible in the residual framework of the tumor. The ducts nearby are all thickened and probably involved by the tumor process.

The lobules are still large and dense and have feathery outlines. They tend to supplant the fat masses in the main portions of the breast. The ducts are large and dense, but they are uniform in caliber. The axillary nodes are often visible when lactation begins, and vary from 0.5 to 3 cm. in diameter.

BREAST ABSCESS

Four cases were examined. All of them were postpartum. In three, localization

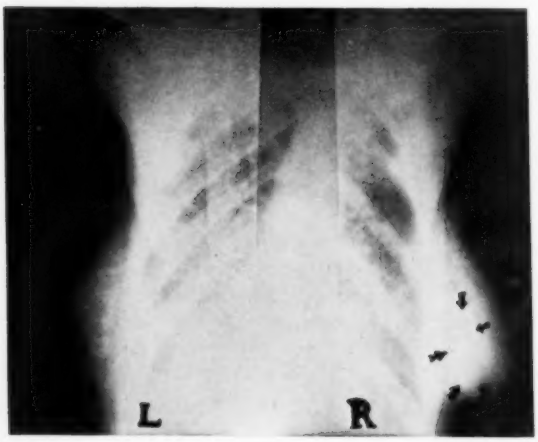

Fig. 10. The left breast is the flat type showing small areas of chronic mastitis. The right breast is larger and shows in addition to the mastitis, a large circumscribed mass in the lower portion. This is probably an area of mastitis and multilocular cysts from its composition. Of course, an area of malignant degeneration could be hidden in this type of lesion.

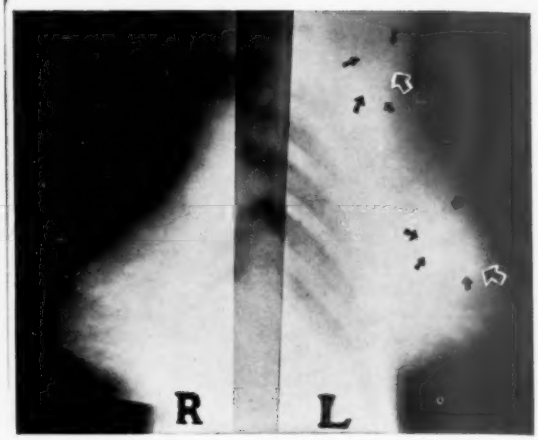

Fig. 11. Showing a large tumor mass (? medullary type of adenocarcinoma) in the upper outer quadrant of the left breast and axillary masses. Diffuse marked chronic mastitis in both breasts. (Cf. Fig. 10.)

was proved correct by incision and drainage. The fourth case was relieved by hot packs and pumping. The localization of the abscess, however, corresponded with the clinical evidence (redness, tension, and pain). In each case, the usual picture of lactation was present with the addition of considerably more of the general haziness than is usual at this stage. A more or less clearly outlined, uniformly dense mass,

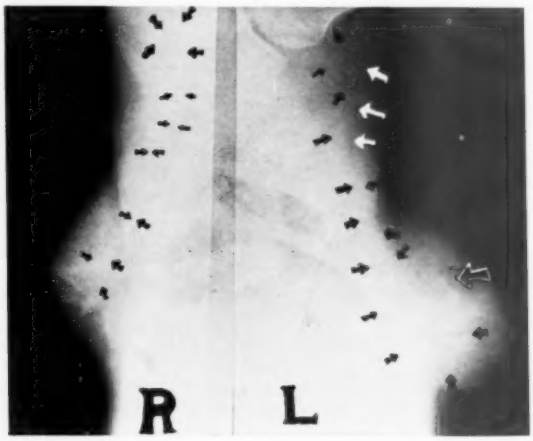

Fig. 12. Large medullary carcinoma of left breast with infiltration of whole breast and the base into the muscles. The tumor can be traced up to the axillary masses by dense strands. The right breast shows also a small mass in the middle below the ducts. This is connected by dense strands through the tail of the breast to a dense axillary mass.

about 2.5 cm. in diameter, could be made out in all three cases. This was not to be confused with overlapping lobules but was quite a distinct entity. In one case, there were two such masses, one in the upper outer quadrant and one in the lower inner quadrant of the right breast. Each yielded about 5 c.c. of purulent material at operation.

The alternate breast in two of the cases showed the increase in the general inflammatory process or congestion to a lesser degree and was free of masses. This difference between the two breasts is of great assistance in the interpretation. The case which was not incised showed multiple small masses in both breasts as well as the large mass identified as the abscess. Follow-up examinations of these cases several months later failed to show any gross scars in the breasts, though some localized thickening may have been overlooked among the still large (lactating) lobules.

CHRONIC MASTITIS

It is very difficult to separate the earliest changes due to inflammatory disease from the normal. If we assume that the two breasts should be alike normally, the abnormalities seen in one which are not present in the other should constitute a working basis for determining the pathological state. If a breast is cut across, the gross appearance of an area of chronic mastitis is that of an area of dense scar tissue replacing and contracting the normal structures. The edges of the diseased area are indistinct. The inflammation tends to involve the duct and lobular structures though the fatty masses may be involved. In the roentgenograms, the appearance is essentially the same: a diffuse or localized scarring and thickening along the ducts and lobules. It may involve one breast, but the process is usually bilateral. The tail and subareolar regions are usually uninvolved. Often localized areas will be slightly hazy suggesting a localized acute or subacute process.

The widespread involvement by mastitis of the majority of breasts examined was quite a surprising discovery. The ease of infection through the ducts and the frequency of trauma probably accounts for much of this inflammatory reaction even in nulliparas. Epithelial overgrowth without serious consequences or tumor formation probably is common also.

BENIGN TUMORS

Benign tumors of the breast are clearly demarcated from the surrounding structures. They are usually homogeneous in density, though they do show connective tissue stroma and a typical arrangement for various types. For instance, the intracanalicular myxoma shows the whorl formation so characteristic of the gross appearance of this type of tumor. The divisions and interweaving of the masses can be clearly seen in the stereoscopic films (see case illustrated). In the fairly uniformly dense benign tumors, the only differentiation between these and malignant tumors of the same density is the continuity of the capsule and the absence of deformation of the surrounding breast structures.

MALIGNANT TUMORS

The chief characteristic of malignant tumors is the distortion of the nearby structures by scarring and puckering and infiltration in an irregular manner of the surrounding structures by the tumor tissue. The appearance is very much like that seen in the gross specimen when it is cut across. The tumor is recognized as a dense sheet or mass of tissue with irregular edges and feathery strands of dense tissue invading the ducts and lobules. There is invasion with puckering and thickening of the skin. Where this is present, it is often very sharply defined; often penetration through the base of the breast is present, and the metastatic infiltration into the pleura can often be traced. The infiltration into the retropectoral lymph nodes with consequent enlargement of the same, and infiltration along the lymph channels into the axilla with enlargement of these nodes can also frequently be noted (Fig. 12). Both the

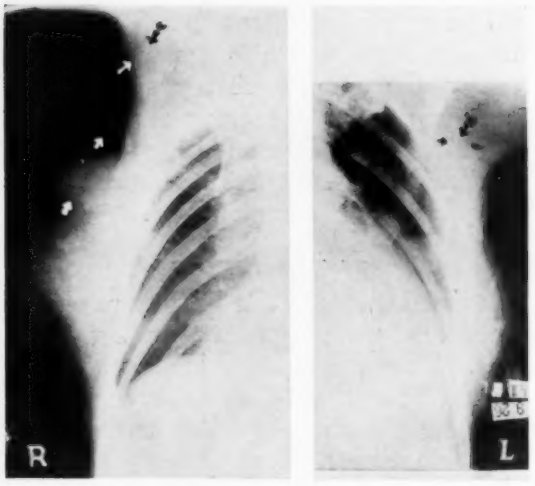

Fig. 13. Medullary adenocarcinoma, partially encapsulated, with infiltration of the skin and metastases to the axillary lymph nodes (*a*) which are very large and dense. Left breast shows chronic mastitis with subacute changes and two small axillary lymph nodes which are barely visible (*b*).

adenocarcinoma of the medullary type and the scirrhous type show this change, the only differentiation being that in the scirrhous type there is more shrinking and scarring and diffuse infiltration than in the medullary type. In the medullary type, the infiltration may occur at only one or two places, usually toward the base or toward the skin, the tumor mass being fairly sharply outlined elsewhere. In certain medullary types of tumors, very rapidly growing, there may be so much expansion of the tumor as to give a sharp border from compression, giving the appearance of a capsule (Fig. 13). The diagnosis is apparent from the invasion through this dense border into the surrounding tissues at one place or another. There is a definite, so-called inflammatory type of adenocarcinoma which involves the whole breast and is commonly bilateral. Accompanying the usual masses with infiltration surrounding them is a diffuse haziness giving the impression that an inflammatory process is coincident with the tumor (Figs. 22 to 26).

Fig. 14. Clinical appearance of same case as in Figure 13 before operation.

Fig. 15. Cross section of same breast as in Figures 13 and 14 showing tumor with compression of breast structures at edges giving the appearance of a capsule.

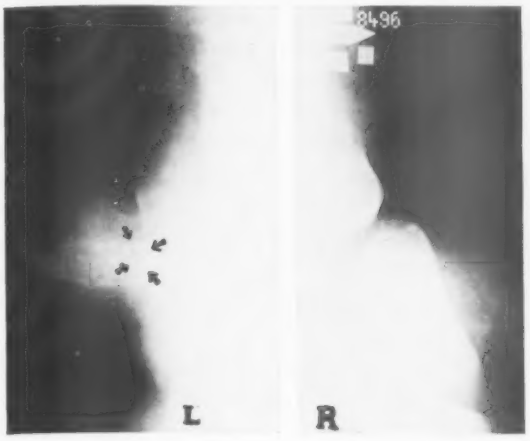

Fig. 16. Showing very little mastitis in the obese right breast. The left breast shows a small irregular infiltrating lesion (2×2 cm.) with small sheets and threads of dense tissue around its periphery. There is no scarring nor distortion of the breast architecture. Diagnosed malignant, probably scirrhous type; operation, adenocarcinoma, unclassified.

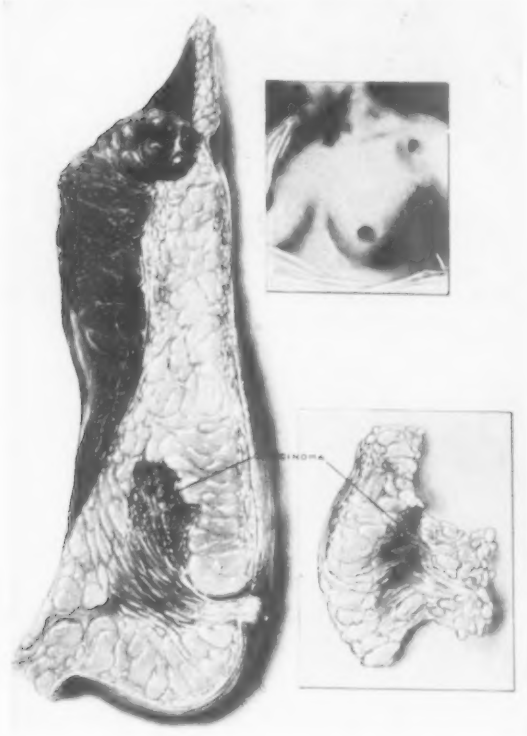

Fig. 17. Showing a drawing of clinical appearance of same case as in Figure 16 before operation, together with a section of specimen.

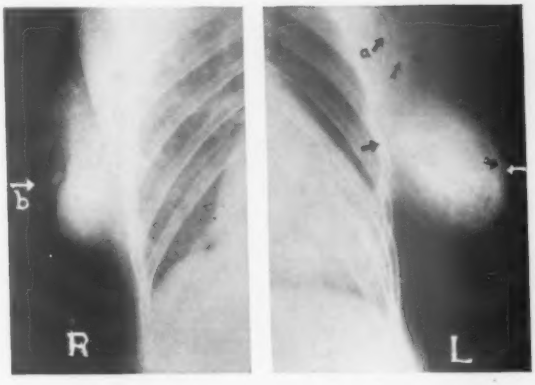

Fig. 18. Left breast: diffuse infiltration by adenocarcinoma (probably scirrhous type) with infiltration of skin and penetration of base. Axillary (*a*) and supraclavicular nodes are involved. Right breast: very little mastitis, practically normal type, shows nipple (*b*) and areola, ducts and acini. The base is free from the pectoralis muscles.

The presence of extensive chronic mastitis is very common in all of the tumor cases studied. This can be studied in the breast which is not involved by the tumor, for, as pointed out previously, the chronic mastitis is usually bilateral and usually fairly equal in its involvement of the

Fig. 19. Same case as in Figure 18 one year later. Shows atrophy of right breast well defined, now discoid type of normal breast. Lung metastases show in this film. Left breast: advanced scarring, infiltration of skin and base by tumor, axillary masses 2 cm. in diameter (*a*).

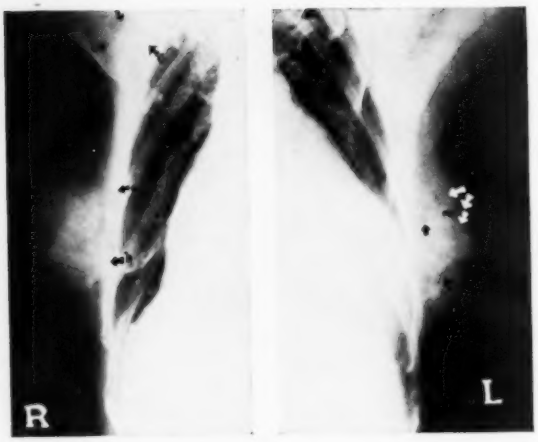

Fig. 20. Advanced medullary adenocarcinoma with ulceration of skin, infiltration through base in two places (*a*) and (*b*) and large axillary mass (*c*). Left breast is a normal type with a few small areas of mastitis and several small cysts.

breasts. The differentiation between the involvement by the tumor and dense infiltrative inflammatory areas is, of course, the most difficult problem which has to be met in this type of diagnosis. The gross appearance, of course, of certain types of chronic mastitis is very difficult to distinguish from early scirrhous carcinoma.

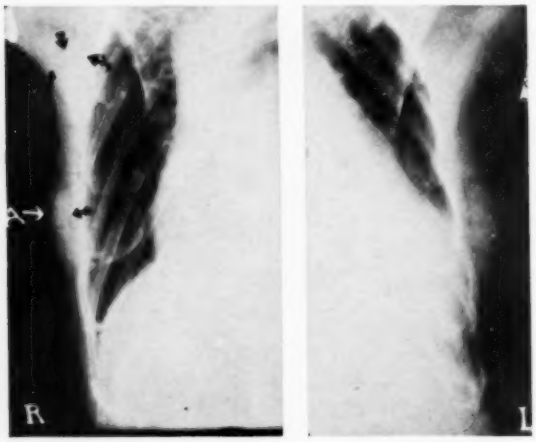

Fig. 21. Same case as in Figure 20 nine months later, showing the atrophy of left breast with the general loss of weight. Right breast, showing shrinkage of (*a*) original tumor, and (*b*) axillary mass under roentgen therapy. The patient died with a silent metastasis in the brain. Autopsy showed atrophic carcinoma cells in masses of scars in the breast.

Both cause scarring and shrinking, and both have strands of dense material invading the surrounding structures. The tumor tissue, however, in the main, is considerably denser and shows a solid mass, varying from 1 to 10 cm. in diameter. It is only the smaller masses that give difficulty in diagnosis. The larger ones are obvious. The presence of small or large cysts in the inflammatory process may further confuse the picture, especially if they are filled with fairly opaque material, for they then give the impression of a dense cellular mass

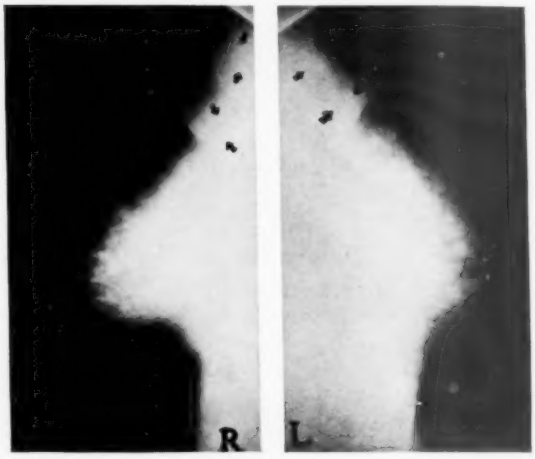

Fig. 22. Very rapidly growing bilateral medullary adenocarcinoma showing the diffuse infiltration with large masses. This picture simulates the lactating breast with abscesses except that the individual masses are very dense. There is a generalized involvement of all of the regional lymph nodes. The bases of both breasts have been obliterated by the tumor.

though their homogeneity and sharp border rather tend to differentiate them from the malignant tumors.

CHANGES FROM IRRADIATION

Through the courtesy of Dr. Burton Lee, 33 cases were studied from the Memorial Hospital of New York. These cases had been treated with both radium and deep roentgen therapy.

In some of these cases the usual characteristics of the tumors were evident. In others, probably the more sensitive to the

Fig. 23. Photographs showing two views of this patient with bilateral adenocarcinoma (colloid type) previous to irradiation. Note the skin infiltration.

radiation, nothing but the connective tissue framework of the tumor mass was visible. The diagnosis was evident from the scarring and distortion of the breast architecture, as well as by the infiltration into the rest of the breast, the base and muscles.

In those cases showing an erythema of the skin over the breast, the underlying breast structures were obscured by a diffuse haziness. This suggested an engorgement of the blood vessels or an actual edema of the breast substance coincident with the skin erythema.

In cases that had not received irradiation for some time, the breast structures were unusually clearly defined, and there was very much less evidence of mastitis than there was in the opposite breast.

RESULTS

In this series several cases have been diagnosed as tumors when they were not

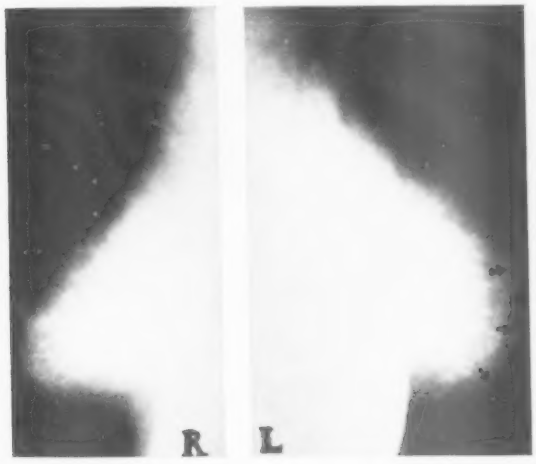

Fig. 24. Same case as in Figure 23 three months later showing the increase in the size of the breasts, increase in the density from scarring (following deep therapy); thickened infiltrated skin over both breasts, destruction of the nipple; axillary masses; infiltration through base with no demarcation of breast from chest wall. There was a very rapid recurrence of the tumor in a few days after maximum radiation treatment and the patient died.

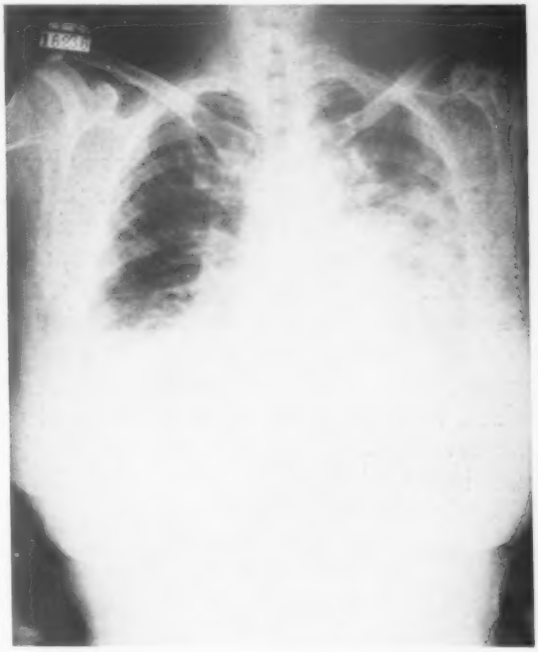

Fig. 25. Same case as in Figures 23 and 24 showing the involvement of both lungs by the metastatic process.

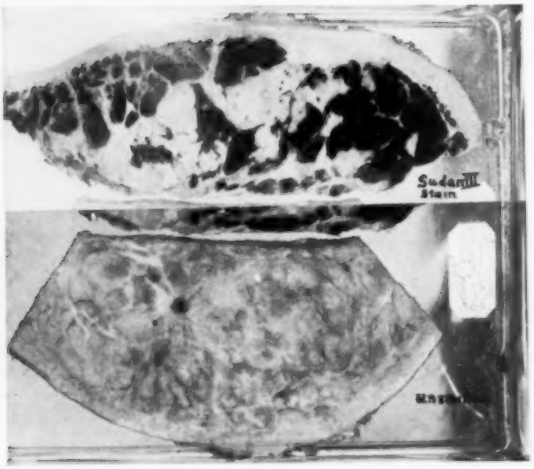

Fig. 26. Specimens showing tumor masses and skin infiltration. The specimen above is stained with Sudan III to show the fat lobules (see roentgenogram of this specimen in Fig. 27).

suspected clinically, and operation has proved that the diagnosis was correct. The tumor masses in each case were less than 1 cm. in diameter, but gave the typical infiltrating and scarring characteristics of an early scirrhous type of carcinoma. Several cases have been erroneously diagnosed as chronic mastitis with cysts. These patients were operated upon because of the masses in the breast, and the masses were found to be scirrhous carcinoma. This error in diagnosis was due in great part to inexperience and a hesitancy upon the part of the examiner to make a diagnosis of malignancy from the roentgenograms, thus subjecting the patient to operation when there was considerable doubt in his mind as to the presence or absence of a malignant tumor. This sort of experience has determined the future policy to be one of less conservatism. In any case of doubt in the examiner's mind, the diagnosis should be "? early carcinoma," "? cystic mastitis." This corresponds to the experience of a great many surgeons when they are in doubt about the presence of tumor from the clinical examination and history. With masses present, it has been found safer to excise the breast than to make a conservative diagnosis. The great rapidity of widespread metastases with the rapid change from hopeful to hopeless state makes this viewpoint justifiable. In many of the cases, there was no unanimity of opinion in the preoperative clinical diagnosis. Several opinions were often held as to the presence of malignant or benign tumors in each case. The opinion from the roentgenogram, on the other hand, was often very definite and, most frequently, correct.

In most of the 8 cases diagnosed incorrectly in the whole series of 119 cases, there was a great deal of disagreement as to the diagnosis clinically. After having more experience, the interpreter reviewed the 8 cases wrongly diagnosed. Four of these were obvious; 3 were malignant, and one was an extensive mastitis. The encapsulated malignant tumor (Fig. 13) would be missed again. A fibroma with mastitis of very dense type would probably be called malignant again. The 2 cases said to be

Fig. 27. Same case two days later than Figure 24. Roentgenogram of a section of the right breast through site of nipple showing infiltration of skin by tumor. Tumor masses of all sizes are visible within the breast substance. Specimen stained with Sudan III (see Fig. 26).

negative by the pathologist could not be studied because the specimens were thrown out before films could be made to locate the supposed small area of malignancy seen at the original examination.

Of the 43 cases coming to operation or post mortem, 33 were examined by dissection after the films were interpreted. Roentgenograms were frequently made of the specimen to study the details when the suspected area could be placed closer to the film. It is only by such follow-up methods that any accuracy can be obtained in diagnosis. Mastitis is so common and widespread that its characteristics must be very carefully studied in order to discriminate it from an early tumor. Serial studies are also of distinct advantage.

Table 1 shows in brief the results of this preliminary study. Of 86 cases of all types from the Strong Memorial Hospital, 43 came to operation or autopsy and can be considered proved. Eight of this series were wrongly diagnosed. On review of the roentgenograms in the light of further experience, at least 4, or one-half of this group, would not be missed. A large part of the remaining 43 cases have been under clinical observation for one to two years. Many have had serial films. None have shown evidence necessitating a change of diagnosis so far.

Of the 33 cases from the Memorial Hospital, New York, 6 had biopsy to verify the diagnosis. Since these were all advanced cases, the diagnosis was mostly obvious.

TABLE I

COMPARATIVE ACCURACY, CLINICAL VERSUS ROENTGENOLOGICAL DIAGNOSIS

Diagnosis by Film	Correct	Incorrect	Proved by operation or autopsy
Malignant tumor	22	3	25
Encapsulated malignant tumors		1	1
Probably malignant—at operation malignant	3		3
Probably malignant—at operation benign		1	1
Probably malignant—at operation mastitis		1	1
Probably malignant—at operation negative		2	2
Intracanalicular myxoma	1		1
Chronic mastitis—no symptoms—(2 years)	4		
Chronic mastitis—no symptoms—(1 year)	24		2
Chronic mastitis with cellular masses, cysts, calcified masses, fibrosis—all non-malignant (1–2 years)	14		4
Prepartum changes	3		
Postpartum changes	3		
Postpartum—lactating	1		
Lactating—with acute abscesses	4		3
Simple obesity (1–2 years)	7		
Simple changes	3		
Total	86	8	43
Irradiated Cases from Memorial Hospital, New York City			
Malignant	23		5
Probably malignant	6		
Chronic mastitis	1		1
Chronic mastitis with cysts or benign tumors	3		
Total	33		6
Grand Total	119	8	49

Of the total 119 cases, leaving the original figure of 8 cases wrongly diagnosed, the percentage of error is 6.7 per cent. Taking only the proved cases, totalling 49, the percentage is 16.3.

SUMMARY AND CONCLUSIONS

A simple technique for taking stereoscopic roentgenograms of the human breast is described.

The appearance in such roentgenograms of the normal breast, whether obese or atrophic, conforms to the anatomical structures which are present.

Abnormalities visible in such films also correspond very closely to the gross appearance of such abnormalities. The roentgen appearance of various types of tumors, both malignant and benign, resembles the gross appearance closely enough to be characteristic of individual types.

The diagnosis made from stereoscopic films of the breast corresponded very closely (85 to 95 per cent) to the operative and autopsy findings. The results from the study of the breast roentgenograms seem to warrant the impression that this type of examination is of distinct clinical value.*

* I wish to thank the surgical staff of the Strong Memorial Hospital for their hearty cooperation in this study, and I am very grateful to Dr. Burton Lee and Dr. Herendeen of the Memorial Hospital of New York City for the opportunity to examine the cases under treatment in their clinic.

DISCUSSION

Dr. P. M. Hickey, Ann Arbor, Mich. It was my good fortune two years ago to be at Rochester where I saw the early work of Dr. Warren. I wish to congratulate him on presenting such an important new contribution to roentgenology. At first sight one may be somewhat doubtful as to its practical importance but the same objection has been raised with other contributions which have been made. I think the work is basic and should stimulate us along a new train of thought.

It occurred to me that it might be helpful in x-raying the mammary gland to employ the technique which the late Dr. Caldwell published, namely, the triangular compensating filter. This consists of a triangular filter made out of German silver or of paraffin in order to hold back the exposure through the thin parts. It might be that such a triangular filter would equalize the exposure and allow the thicker parts of the breast to be differentiated without over-exposing the thinner parts.

Personally I did some of this work in a very desultory way a few years ago in the service of Dr. Manton at the Woman's Hospital in Detroit. Our exposures were made with the idea of studying the structure of the lactating breast. Lately since knowing about Dr. Warren's work I have made a number of roentgenograms of the breast amputated for carcinoma. These studies are very helpful in the interpretation of films of the normal and pathological breast.

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SUBPHRENIC ABSCESS*

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THE clinician is sometimes confronted with the problem of making the diagnosis of a condition which has physical signs common to a pathological process involving the structures either in the base of the thorax or in the upper region of the abdominal cavity. In order to make the diagnosis, he finds it necessary to call upon the roentgenologist for his assistance. The roentgen examination frequently gives the most precise and definite information in regard to the character of such a process. The condition which most frequently offers such difficulty in diagnosis is subphrenic abscess.

Subphrenic abscess is attended by a very high mortality rate if not treated by surgical drainage. With an early and a correct diagnosis and proper surgical treatment, the mortality rate may be reduced about 60 per cent. A complete roentgen examination, with an accurate interpretation of the roentgen evidence, is one of the most essential aids in making the diagnosis of this condition.

A review of the literature shows that much has been written on the subject of subphrenic abscess. It was first described by Barlow[1] in 1845. In 1880 von Leyden[4] published his article on "Pyopneumothorax subphrenicus." He established criteria for making the diagnosis clinically and reported three cases which he had diagnosed during life and in which the diagnosis was confirmed by autopsy. In 1908, Barnard[2] published one of the best articles on this subject which appears in the literature. He describes the anatomy of the subphrenic space and presents a very clear description of the general subject. He describes in detail the etiology, symptomatology, physical signs, diagnosis and treatment of subphrenic abscess occurring in each of the six subphrenic spaces. In 1921, Lockwood[3] published his observations, reporting 113 cases observed at the Mayo Clinic. Many others have contributed valuable information, emphasizing various phases of the subject.

ETIOLOGY

Subphrenic abscess may follow infection in the peritoneal cavity or in any of the organs or structures in contact with the under surface of the diaphragm. Rarely, it may follow infection in the lung or pleural cavity. About one-sixth of the cases result from distant foci of infection. Cases have followed carbuncles and infected burns. About two-thirds of the cases follow abdominal operations. Perforated gastric or duodenal ulcer, and appendicitis, are the cause of more than half of the cases. The etiology seems to vary with the prevalence of certain diseases in different localities. This is illustrated in the 76 cases reported by Barnard.[2] One-sixth of these were due to hydatid or to tropical abscess of the liver. In 15 proved cases at St. Alexis Hospital, the etiology was as follows:

Appendicitis	8	about 53%
Ruptured Ulcer:	5	about 33%
Gastric 3		
Duodenal 1		
Gastrojejunal 1		
Trauma, with fracture of the lower right ribs and injury to the right abdomen	1	
Unknown	1	

ANATOMY

A knowledge of the location and boundaries of the subphrenic spaces is essential for a thorough understanding and proper interpretation of the signs elicited by roentgen examination. Only with such knowledge can one accurately designate

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the location of the abscess. The subphrenic space is divided by the cruciform arrangement of the ligaments of the liver. The falciform ligament divides the space into right and left and these, in turn, are divided into intraperitoneal and extraperitoneal by the peritoneal reflections on the liver. In the literature there appears some difference of opinion as to the limits and boundaries of these spaces, but the description presented by Barnard[2] is generally accepted and quoted. He divides these spaces as follows:

(A) Intraperitoneal:	I Right	1. Anterior
		2. Posterior
	II Left	3. Anterior
		4. Posterior
(B) Extraperitoneal:		5. Right
		6. Left

The right anterior intraperitoneal space is the only true subphrenic intraperitoneal space on the right side. The right posterior intraperitoneal space is the subhepatic fossa. The left anterior intraperitoneal space is the only true subphrenic intraperitoneal space on the left side. The left posterior intraperitoneal space is the lesser peritoneal cavity. There is free communication between some of these spaces. The right and left paracolic grooves are continuous with the right and left subphrenic spaces. These communications make it possible for infection to spread from one space to another and also for infection to get into these spaces from the pelvis or the lower abdominal regions. With the patient lying on the back, in a horizontal position, the highest part of the posterior abdominal wall is the lumbar region. This forms a watershed. This watershed is important because it acts as a barrier, causing infection to gravitate either into the pelvis or into the subphrenic space. This is one of the fundamental reasons for the adoption of Fowler's position for the prevention of subphrenic abscess in the presence of infection in the peritoneal cavity.

PATHOLOGY

The pathology of a subphrenic abscess in the intraperitoneal space is that of a localized peritonitis. At first, there is a profuse exudation of serum with symptoms of peritonitis. In a few days, the serum becomes turbid with leucocytes. The margins of the infected area begin to be defined about the fourth day by a lymph barrier, which localizes and contains the forming abscess. At first, the contents are diffused in irregular spaces, but, as time goes on, the barrier contracts and limits the space. It takes from eight to fourteen days for the abscess to become localized. Any of the pus-forming organisms may be found in the abscess.

HISTORY

The history of a subphrenic abscess is that of the disease or condition which is the cause of the abscess, in addition to which there is the history of an infective or suppurative process. The history often is obscure in the insidious cases, especially in those which do not follow a surgical operation. Two-thirds of the cases follow abdominal operations. To think of the condition is a great aid in making the diagnosis. Subphrenic abscess always should be suspected in the presence of an unexplained fever following an abdominal operation, in just the same manner as empyema is suspected when a septic temperature follows pneumonia. In those cases which follow ulcer of the stomach or duodenum, the onset is usually not abrupt. As a rule, there is clinical evidence of a ruptured ulcer, which is followed by symptoms and signs of a suppurative process. These symptoms merge so that the presence of a subphrenic abscess may not be suspected until the signs of a pathological process at the base of the chest become pronounced. In a case following operation for appendicitis, there is usually definite improvement for a certain interval of time, followed by signs of a suppurative or infective process, with evidence of involve-

ment of the structures at the base of the chest. These signs are often mistaken for empyema or pneumonia.

PHYSICAL SIGNS

There are present the general signs of sepsis, with irregular temperature, loss of weight, sweating and weakness. The temperature ranges from 99° to 102° F. The pulse is usually around 120. The respiratory rate is little affected; it is not commensurate with the elevation in temperature and pulse, nor with the apparent extensive involvement of the structures within the chest. Examination of the chest reveals signs of compression and, at times, inflammation of the lower portion of the lung on the affected side. These signs are often mistaken for empyema or pneumonia. The position of the heart and mediastinal structures is important in the differential diagnosis. They are not displaced in subphrenic abscess, while in empyema there is definite displacement away from the affected side. There is no evidence of excursion of the diaphragm. Theoretically, there should be an increased flare of the costal arch on the affected side but this is not always present, as is so well pointed out by Dexter.[3] All of the cardinal signs of underlying inflammation may be present. Pain and edema in the region of the abscess occur in many of the cases. Pain, referred to the neck or shoulder, or along the distribution of the intercostals, is not uncommon and is often one of the earliest and most significant symptoms. The liver is rarely displaced downward; it is usually fixed by adhesions along its lower border and, as a result of this, the diaphragm is displaced upward, causing an apparent increase in the vertical liver dullness.

ROENTGEN EXAMINATION

The roentgen evidence, properly interpreted, is of great value in making the diagnosis of subphrenic abscess. In those cases in which fluid and gas are present, the diagnosis can be made by the roentgenologist alone; but when no fluid level can be seen, the roentgen evidence is more difficult to interpret and the diagnosis can only be made by correlation of the roentgen findings with the clinical symptoms.

In order to obtain all the roentgen evidence, roentgenoscopic and roentgenographic examination must be made. The roentgenoscopic examination is facilitated by the use of a tilt roentgenoscopic table. The patient may be placed on the table when it is in a horizontal position and then, with little discomfort, the patient may be examined in various positions by tilting the table from the Trendelenburg to almost the vertical position. Very sick patients may be elevated to an angle of 45° without much discomfort and most of them may be elevated to 75°. This is very important in the search for fluid levels.

The roentgenoscopic observation gives information which is important in determining the various positions in which roentgenograms are to be made. The following points should be noted in the roentgenoscopic and roentgenographic examination:

1. The position of the mediastinal structures.

2. The position, contour and excursion of the diaphragm.

3. The condition of the lung space.

In the uncomplicated case, the heart and mediastinal structures are not displaced. The diaphragm on the affected side is elevated, usually, to the level of the third or fourth rib anteriorly. The arch is more acute than normal. There may be slight excursion, but the diaphragm is usually fixed in its position. The lung space above the diaphragm is clear. If gas is not present in the abscess, the density beneath the diaphragm is homogeneous and cannot be differentiated from that of the liver. The vertical liver density is increased. When gas is present in the abscess, if the patient is placed in an upright posture, there will be an area of decreased density just below the diaphragm, with a fluid level below the gas. Waves can be

produced in this fluid level by shaking the patient.

Roentgenograms made in the postero-anterior position will show whether the abscess is on the right or left side. Roentgenograms made in lateral position will often show in which space it is located. If the abscess has been present for any considerable period, there is often a small area of density found in the costophrenic angle. This is due to pleuritis, with a small amount of fluid. When the abscess occurs on the left side, with gas and fluid level, the fluid is seen to be agitated by each heart beat, forming a wave. If gas is present in the abscess, the limits of the abscess cavity can be determined by making roentgenoscopic or roentgenographic observations of the patient in various positions.

A considerable number of these patients are referred to the roentgenologist with a diagnosis of empyema and the striking feature of the case is the fact that there is no roentgen evidence to support the diagnosis of empyema, in spite of the apparent marked clinical evidence of it. The heart and mediastinal structures are in normal position; the diaphragm is elevated and usually fixed in its position, and the lung space is clear. This combination of facts clinches the diagnosis. If there is gas present in the abscess, with a fluid level, the diagnosis is easily made.

Subphrenic abscess may be single or multiple. It may occur on both sides at once or there may be several pockets on one side. When a pleuritis or pneumonitis following subphrenic abscess has become extensive, there is marked density in the lung space, obliterating the outline of the diaphragm and making it impossible to determine the presence of a subphrenic abscess by roentgen examination unless gas is present in it.

If, after the roentgen examination, a definite diagnosis cannot be made, it is important to repeat the examination at biweekly or weekly intervals. When the diagnosis of subphrenic abscess has been established and drainage instituted, serial roentgen examinations, made weekly, are useful in the study of the progress of the condition, especially in regard to the position and function of the diaphragm. When drainage is sufficient and the patient is proceeding to uncomplicated recovery, there is a gradual return of the diaphragm to normal position. The return to normal function is very slow and lags behind the clinical progress. Some cases show very little excursion of the diaphragm when all clinical and subjective evidence of the abscess has disappeared. Roentgen examination of the chest is very helpful in detecting pulmonary and pleural complications of subphrenic abscess. We have observed abscess of the lung as a complication in several cases.

THE EXPLORATORY NEEDLE

Most writers agree that the use of the exploratory needle is dangerous practice and that its use should be condemned. Some advise its use as a prelininary step in the operation for drainage of the abscess. It is our practice not to use it and we advise against it.

COURSE

If the patient is not operated upon, the symptoms become more pronounced and the outcome is usually fatal. If proper surgical drainage is instituted, the symptoms subside and the patient goes on to recovery unless this is interrupted by one of the following complications: additional subphrenic abscess, abscess of the lung, spontaneous rupture into a bronchus, pleural cavity, pericardium, colon, stomach, or through the skin. One of our cases developed an additional subphrenic abscess and abscess of the lung, with fatal termination. In another case, following gangrenous appendicitis, there developed an abscess of the lung and an abscess in the pelvis. Surgical drainage of the abscess of the lung and of the abscess in the pelvis was instituted and the patient made complete recovery. Three cases had spontaneous rupture: one, into the pleura,

with fatal termination; one, into a bronchus, and one, into the colon; both made complete recovery. Lockwood[5] points out that there is little danger of spontaneous rupture of subphrenic abscess into the peritoneal cavity.

TREATMENT

Recovery from subphrenic abscess is dependent upon free drainage, either spontaneous or surgical. Spontaneous drainage through a bronchus, through the intestinal tract, or through the skin, may occur with recovery, but it is rare. Surgical drainage offers the best chance for recovery. To obtain the maximum benefit from surgical treatment, the location of the abscess must be determined and the method of approach to the abscess must be governed by the stage of the inflammatory process at the time of observation. It takes from eight to fourteen days for a subphrenic abscess to become localized. In general, in the stage of diffuse inflammation, drainage through the abdomen gives the best results. After the abscess has become localized, the transpleural method is advisable. Of course, the latter procedure is to be done in two stages, unless pleural adhesions, which will protect the general pleural cavity from infection, have already formed.

CASE REPORTS

Case 1. (Figs. 1 and 2.) Female, aged twenty-six. Admitted to the hospital on May 13, 1925. Illness began May 10, 1925. General pain in abdomen; no nausea nor vomiting. Expelled small fetus; did not know she was pregnant. Bleeding stopped in several days and then nausea, vomiting and diarrhea appeared. The patient was operated on May 18 and an appendicial abscess high up on the right side adherent to the side of the abdomen, at the level of the umbilicus was found. Temperature before operation ranged from 99° to 102°F. Did not change after operation. Investigation was made to determine the cause of the elevation of temperature. Subphrenic abscess was suspected June 2, 1925. A roentgen examination made on June 4 showed subphrenic abscess on the right side; no gas; lung clear. This

Fig. 1. Case 1. June 9, 1925. Right diaphragm high, fixed in its position.

abscess was drained through the incision which had been made in the abdomen at the time of operation for appendicitis. Examination on June 9 showed the same findings. The patient

Fig. 2. Case 1. Sept. 19, 1925. Normal findings.

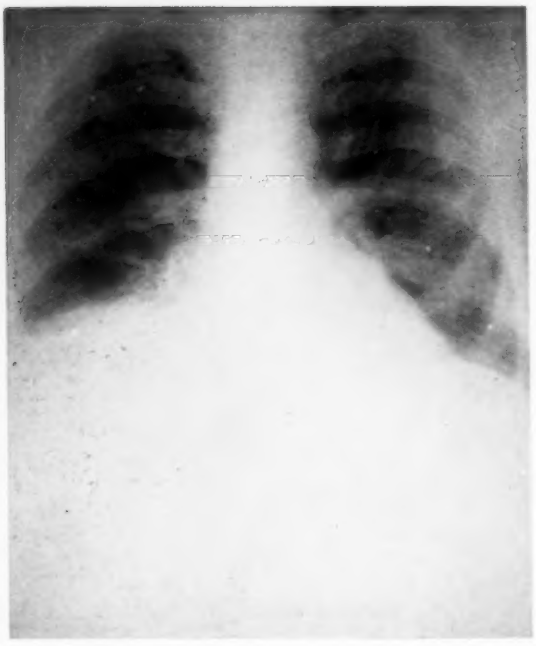

Fig. 3. Case II. Nov. 30, 1925. Subphrenic abscess on the right side, with gas and fluid level beneath the diaphragm; excursion present but very slight —almost nil.

began to show some improvement and left the hospital with the idea of returning later, if necessary, for operation for the subphrenic abscess. No further operation was performed. Roentgen examination on September 19, 1925, showed normal chest findings. The patient had made a complete recovery. Blood culture was negative; no other culture made. Etiology: appendicial abscess.

Case II. (Fig. 3.) Male, aged forty-eight. Admitted to the hospital on November 28, 1925; discharged February 6, 1926. Two days before admission the patient had pain across the abdomen, with vomiting. Patient had hernia and was unable to reduce it. Intestinal obstruction and acute appendicitis were suspected. Signs developed in the chest indicating empyema. Roentgen examination on November 30, four days after beginning of illness, showed subphrenic abscess on the right side, with gas and fluid level beneath the right diaphragm. A two-stage, transpleural operation was performed. Pus, gas and fecal material were found beneath the diaphragm. Gastrointestinal examination on December 16 showed that there was a developmental anomaly. The cecum had not descended and was fixed in a high position beneath the liver. There was a fistula between the cecum and the abscess cavity which drained through the chest. No cultures were made. After a rather stormy period, the patient left the hospital, Feb. 6, 1926, with a discharging sinus in the chest.

The patient returned to the hospital on March 14 and after further study and consideration it was found that the patient had a fecal fistula connected with the cecum and draining out through the sinus in the chest wall. The patient was operated on with the idea of eliminating the fistula. There was a mass in the right upper quadrant, which involved the right portion of the colon and the terminal ileum, and the surgeon decided to resect the terminal ileum and the right portion of the colon and to anastomose the ileum with the remaining portion of the colon. This anastomosis was made and the terminal ileum and upper portion of the colon were removed. The patient died seven days after operation. Autopsy showed evidence of general peritonitis and bronchial pneumonia. Etiology: ruptured appendix, with perforation; appendix located in a high retroperitoneal position.

Fig. 4. Case III. Dec. 27, 1926. Subphrenic abscess on right side. No gas. Some pneumonitis at the right base.

Case III. (Figs. 4 and 5.) Female, aged nineteen. Admitted to the hospital on December 6, 1926; discharged January 29, 1927. Two days before admission, patient had nausea and vomiting, followed the next day by pain in the right lower quadrant, growing worse. Operation on December 6 showed a retrocecal appendix, gangrenous and perforated; free pus in the peritoneal cavity. The appendix was removed and drainage instituted. At the time of operation the temperature was 103°F. It continued high and came down to 102° on the sixth postoperative day. It ranged between 100 and 102° until the twenty-fourth postoperative day. Roentgen examination on December 27 showed subphrenic abscess on the right side; no gas; some pneumonitis at the right base. A transpleural two-stage operation was performed. There was pus beneath the right diaphragm. Culture negative. A second roentgen examination on January 29 showed the diaphragm about one inch higher than normal; adhesions at the periphery; excursion limited. White blood count—on admission: 16,500; December 23: 12,900; December 27: 13,600. The temperature was normal nine days before discharge. Patient made a complete recovery and has been well since. Etiology: retrocecal appendicitis.

Fig. 5. Case III. Jan. 29, 1927. Diaphragm about one inch higher than normal. Adhesions at the right base.

Fig. 6. Case IV. Nov. 19, 1928. High right diaphragm; excursion present but very slight; no gas in the abscess.

Case IV. (Figs. 6, 7, 8, 9, 10 and 11.) Male, aged sixteen. Admitted to the hospital on October 24, 1928; discharged March 29, 1929. An appendectomy on October 24 revealed a gangrenous appendicitis. The wound was opened on October 31 and a large amount of pus drained. Drainage continued for about two weeks, then diminished. Roentgen examination on November 19 showed subphrenic abscess. The patient was operated on for subphrenic abscess on December 7. A large amount of foul-smelling pus was evacuated. The patient improved for a time but later began to run a septic temperature. Roentgen examination on January 24 showed the right diaphragm much higher than normal; excursion practically nil. There was a round area of density about the size of an orange, sharply defined and located at the right base posteriorly. Conclusion: subphrenic abscess on the right side. Large abscess of the lung located in the posterior portion of the right base. Abscess of the lung drained by surgical procedure on January 29. Patient again improved for a time but later began to run a septic temperature. A roentgen examination was made on March 11 and an abscess in the pelvis was found. This

Fig. 7. Case iv. Nov. 19, 1928. Roentgenogram of abdomen showing large amount of gas.

Fig. 9. Case iv. Jan. 25, 1929. Lateral view. Abscess located in posterior portion of the lung.

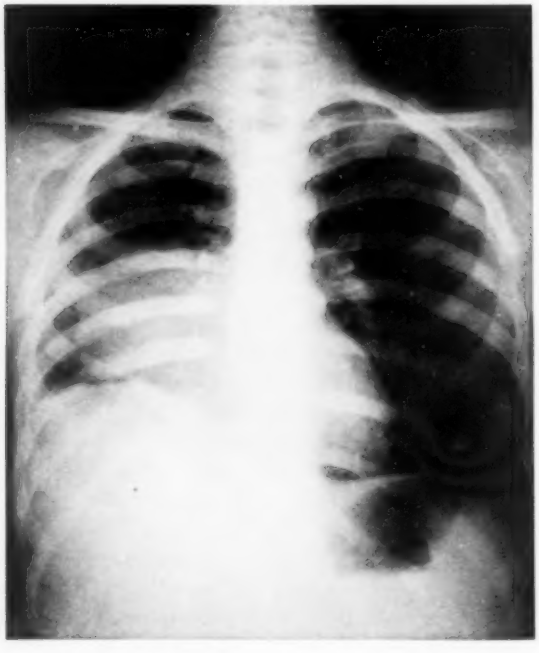

Fig. 8. Case iv. Jan. 25, 1929. High right diaphragm; subphrenic abscess; large abscess in the lung.

Fig. 10. Case iv. March 11, 1929. All evidence of abscess in the lung has disappeared. Right diaphragm is elevated and excursion is present but decreased.

was drained and the patient made a final and complete recovery. He has resumed his previous occupation.

The study of this case shows the difficulty of making the diagnosis of subphrenic abscess in the presence of other conditions which could account for the symptoms. The diagnosis was made by a correlation of the roentgen evidence with the clinical findings. The value of serial roentgenograms is also shown by the fact that the abscess of the lung was discovered by the roentgen examination before it was suspected by the clinician.

Fig. 11. Case iv. March 11, 1929. Lateral view shows that all evidence of abscess of the lung has disappeared.

Case v. (Fig. 12, 13, 14 and 15.) Male, aged six. Admitted to the hospital December 29, 1928. Illness began December 27, 1928, with chills and fever. No vomiting. On admission there were signs of right lower lobar pneumonia, with congestion over the left lung. Abdomen rigid and tender. Definite peritoneal irritation. Temperature, 103°F; respiration, 44; pulse, 128. Patient was in the hospital two weeks, during which time the temperature ranged from 99 to 102°; pulse, 120; respiration,

Fig. 12. Case v. Jan. 18, 1929. Subphrenic abscess with elevation of right diaphragm, considerable gas beneath the diaphragm and a definite fluid level.

Fig. 13. Case v. Jan. 18, 1929. Examination made in horizontal position shows that the gas pocket extends down to the level of the crest of the ilium.

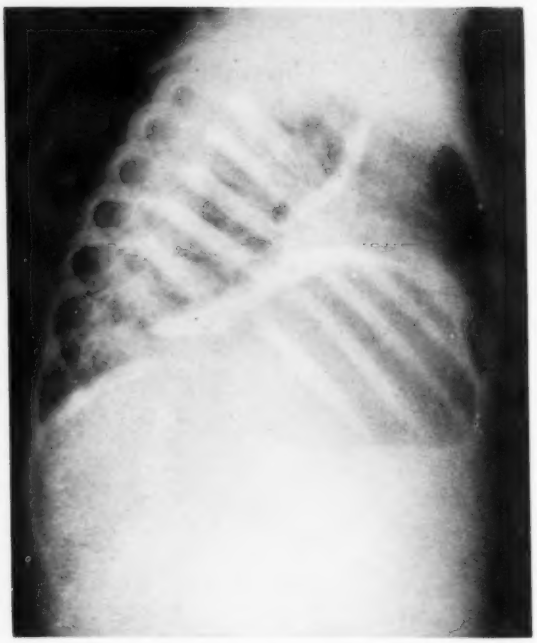

Fig. 14. Case v. Jan. 18, 1929. Lateral view, upright position, showing large gas pocket located in anterior intraperitoneal space.

30. White blood count: December 31, 19,000; January 4, 26,000; January 11, 14,000. Diagnosis; pneumonia. The patient left the hospital and returned in a week.

Second admission, January 18, 1929; discharged, January 28. Patient returned in about the same condition as he was when he left the hospital. Temperature for a week following admission was 99–102°; pulse, 110–120; respiration, 30. For the last three days in the hospital: temperature, 100°; pulse, 110; respiration, 25. White blood count on admission, 8,800.

Roentgen examination on second admission, January 18, showed a large subphrenic abscess on the right side, in the anterior intraperitoneal space. Large collection of gas. Right diaphragm at the second interspace. An operation was done on January 19. First incision in the right abdominal wall below the costal margin. Adhesions were found; no pus nor gas; abdomen closed. Second incision over the right kidney region. Exploration of this region gave no signs of gas or fluid. Wound closed with drainage. For a week following this operation the patient's condition remained about the same. At this time the patient began to show evidence of some blood in the stool. Stools were described as yellow. First yellow stool January 24; blood appeared January 27. These signs indicate that the abscess ruptured into the colon and was drained by that means. Roentgen examination on January 26 showed that the subphrenic abscess was still present. Right diaphragm was one interspace lower. Amount of gas was less. Amount of fluid increased. Roentgen examination March 23 showed some limitation in excursion of the right diaphragm; adhesive pleuritis at the periphery, holding up the diaphragm. These signs are the only remaining evidence of the previous subphrenic abscess; other chest findings normal. After leaving the hospital the patient showed continual improvement and made a complete recovery. Etiology: appendicitis.

Case vi. (Fig. 16.) Male, aged fifty-four. Admitted to the hospital November 20, 1928; discharged, December 6, 1928. Pain in abdomen and shortness of breath for four days before admission. White blood count on admission, 16,000. Operation, November 21. Walled-off abscess between cardiac end of stomach and spleen. Foul-smelling pus; no

Fig. 15. Case v. Jan. 26, 1929. Decrease in amount of gas and lowered position of diaphragm.

culture; drainage. Diagnosis: ruptured gastric ulcer and left subphrenic abscess. Patient left the hospital with a temperature ranging between 99 and 102°F. There was drainage through the incision and this drainage continued at home.

Returned to the hospital January 14, 1929; discharged, January 18, 1929. Just before the second admission to the hospital the patient developed some trouble in the chest. White blood count: January 14, 15,400; January 17, 8,500. On January 14 the patient began spitting up brown, foul-smelling sputum. This was due to spontaneous rupture of the abscess. Drainage through one of the lower left major bronchi. Temperature January 14, 102°; the next day and two following days, 99°.

Roentgen examination on January 15 showed left subphrenic abscess; small gas pocket; diaphragm fixed; no excursion. Patient left the hospital and continued to cough up foul-smelling material for several weeks. This gradually stopped. Cough gradually stopped but drainage through abdominal wound continued for several weeks. A roentgen examination was made March 25. Examination of stomach and duodenum showed no evidence of ulcer or other organic pathology of the esophagus, stomach or duodenum. No evidence in the history to indicate any abnormality of the colon. Daily bowel movements, generally normal. Examination of the chest shows normal findings, except relatively high position of the left diaphragm. Patient states that he feels well and all the symptoms of his recent trouble have disappeared. He has resumed his work as a cobbler. Etiology: ruptured gastric ulcer.

Fig. 16. Case VI. Jan. 15, 1929. Left subphrenic abscess; small gas pocket; diaphragm fixed; no excursion.

Fig. 17. Case VII. Jan. 13, 1929. Upright position. Gas and fluid level beneath right diaphragm. Slight excursion.

Case VII. (Figs. 17, 18, 19 and 20.) Male, aged fifty-one. Admitted January 11, 1929; died February 9, 1929. History: Sudden, sharp pain in right epigastric region at 5 P. M. on January 11. Pain referred to right shoulder. No other symptoms. Tenderness and rigidity in right upper quadrant. History of previous gastrointestinal disturbance typical of duodenal ulcer. White blood count on admission, 16,000; temperature, 97.2°F.; pulse, 80; respiration, 30. Suspected diagnoses: gall-bladder disease; ruptured ulcer; fluid in left chest.

Roentgen examination was made on January 13, 1929. Subphrenic abscess on right side with gas and fluid. There was improvement on Sippy diet. Operation January 24. Transpleural. First stage, through ninth interspace. Gas and foul-smelling pus, indicating colon

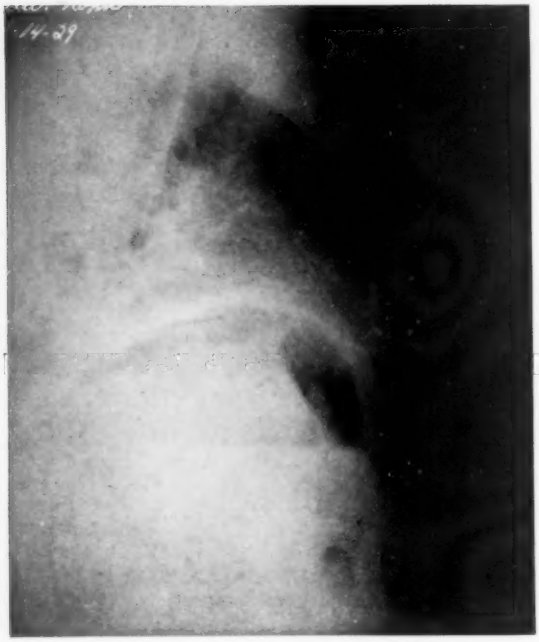

Fig. 18. Case vii. Jan. 14, 1929. Lateral view, upright position, showing collection of gas in anterior intraperitoneal space.

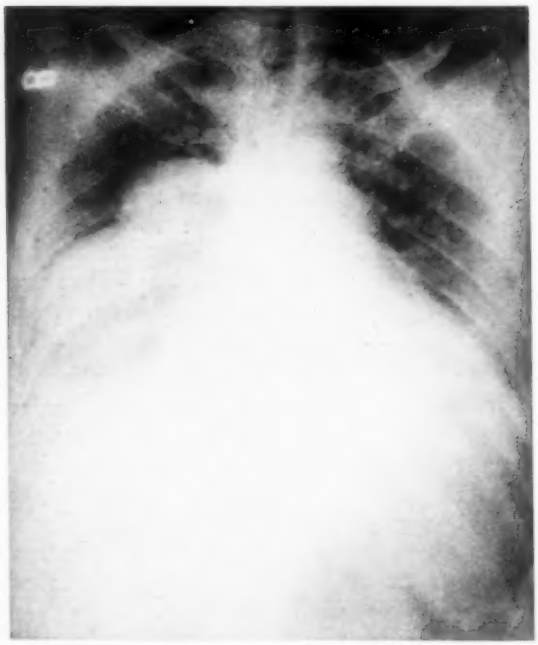

Fig. 19. Case vii. Feb. 4, 1929. Examination made in semi-erect posture at the bedside shows a high right diaphragm and area of density in the region of the hilus. Subphrenic abscess. Abscess of the lung.

infection. No culture. No improvement after operation. Temperature ranged between 99 and 101°. Second roentgen examination on February 3 showed abscess of lung at hilus; new pocket of pus posteriorly beneath the diaphragm; additional subphrenic abscess. White blood count February 5, 26,000. Died February 9. Etiology: ruptured duodenal ulcer.

Case viii. (Figs. 21 and 22.) Male, aged forty. On February 7, 1927, had anterior gastroenterostomy for duodenal ulcer. Returned

Fig. 20. Case vii. Feb. 5, 1929. Air pocket located beneath the posterior portion of the diaphragm and farther back than it was in previous examination.

to work in April, 1927. Worked until October, 1928. Admitted to hospital on October 3, 1928. Five days before admission pain began in epigastrium, which became localized, accompanied by nausea and vomiting. Pain persisted in left upper quadrant. Had similar attack two months ago which lasted for two days. Temperature after admission ranged between 99 and 102°F.

Roentgen examination on October 4 showed a high left diaphragm with limited excursion, with large gas pocket underneath the anterior portion, anterior to and above the stomach. No fluid. Gastrointestinal examination was made. There was some barium in this gas pocket at the six-hour examination. Gastro-

enterostomy visualized. Little barium passed into the distal loop. Some six-hour gastric retention. Operation October 16. Left abdominal incision. Left subphrenic abscess. Large amount of foul-smelling pus. Perforated gastrojejunal ulcer. Abscess was drained. Ulcer was turned in. After recovery from this operation the patient was again examined roentgenologically, on December 10. Chest showed normal findings. Right and left diaphragms were normal in position and excursion. No evidence of gas or fluid beneath the diaphragm.

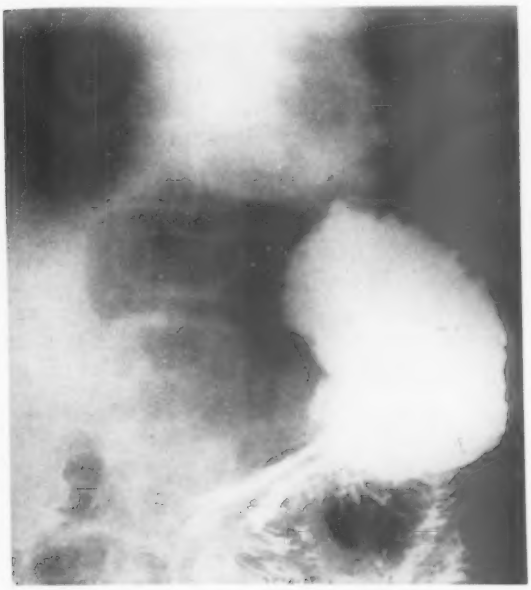

Fig. 21. Case VIII. Oct. 4, 1928. Large gas pocket above stomach beneath the left diaphragm. Excursion of the left diaphragm definitely present but limited.

Subsequently, jejuno-jejunostomy was performed. Patient made a good recovery and the doctor now reports patient is back at work, has gained about 40 pounds and feels fine. Etiology: ruptured gastrojejunal ulcer.

Case IX. (Figs. 23, 24 and 25.) Male, aged thirty-three. Admitted November 27, 1928. Two months before admission patient fell and struck the right side of the abdomen. Continued working. One month before admission he caught cold. Since then has had pain in right lower chest and pinching sensation on deep inspiration, with shortness of breath and night sweats. Before admission he was aspirated twice, with no results. Had lost 30 pounds in weight.

Fig. 22. Case VIII. Oct. 4, 1928. Lateral view, upright position, shows gas located beneath the anterior portion of the diaphragm.

Roentgen examination on November 27 showed subphrenic abscess on the right side;

Fig. 23. Case IX. Nov. 27, 1928. High right diaphragm; fixed in its position; no gas; homogeneous density.

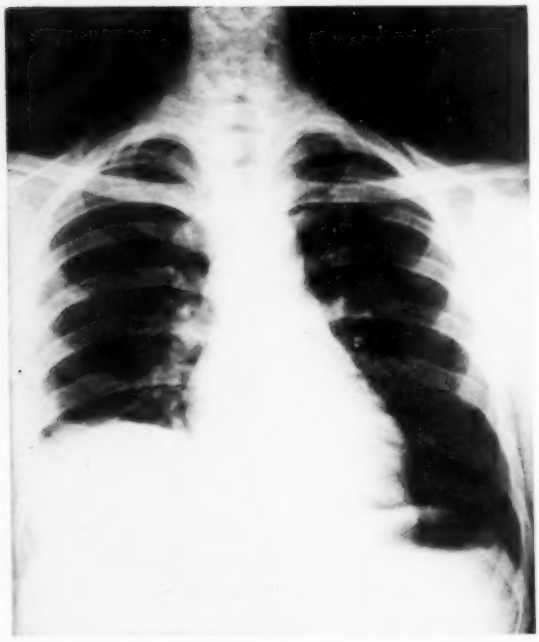

Fig. 24. Case ix. Dec. 3, 1928. The position of the diaphragm is lower; other findings the same.

no gas, diaphragm splinted. Temperature 102°. Operation on November 28. Incision over fluctuating mass on right side near the axilla between the seventh and eighth ribs. A large amount of foul-smelling pus was discharged. Culture showed gram-positive cocci. White blood count, 11,200. The patient began to improve and made a good recovery. Left hospital feeling much better and gaining weight.

He returned for roentgen examination two months later. At this time the patient had regained almost all his lost weight and was feeling fine. Gastrointestinal examination was negative, except for questionable evidence of duodenal ulcer. No clinical evidence of duodenal ulcer. Right diaphragm was still elevated and excursion was slight. Other chest findings normal. At present patient is working and feeling well. Etiology: unknown. Injury?

Case x. Male, aged fifteen. Admitted December 20, 1926; died the same day. About two weeks before admission patient was wrestling and later complained of pain in upper right abdomen. About one week after wrestling incident signs of ecchymosis developed over the lower right chest, indicating hematoma. At this time patient had pain in upper right abdomen. Signs were vague and symptoms indefinite. There were signs of pathology in the chest. No definite diagnosis was made. Patient progressed fairly well for about one week, when suddenly he developed shortness of breath and pain in the right chest. He was then admitted to the hospital and right chest was tapped. Foul-smelling pus was removed. On admission, temperature 102°, pulse 120, respirations 44. Physical examination showed heart rapid and displaced to the left. Dullness over the right chest, from the first rib down. Distant breath sounds. Interspaces bulging. Large area in which amphoric breath sounds were heard over the right chest. Coin sound and succussion splash were present. Upper right quadrant bulging and rigid. Diagnosis: ruptured appendix; subphrenic abscess which had ruptured into pleural cavity. No roentgen examination made.

Autopsy. No free fluid in abdominal cavity; right subphrenic abscess; high cecum. Retrocecal appendix adherent to the liver. Signs of recent inflammation and necrosis around the appendix. Fluid in right chest same as in subphrenic abscess. Right lung collapsed to about one-eighth of its size. Consolidation of the left

Fig. 25. Case ix. Jan. 18, 1929. The position of the diaphragm is lower but not quite normal. The function is improving. Excursion is present but limited.

lower lobe. Pathological diagnosis: acute appendicitis; subphrenic abscess right; empyema right; lobar pneumonia left. Etiology: appendicitis; complication of subphrenic abscess ruptured into pleural cavity; fatal outcome.

Summary of Fifteen Cases of Subphrenic Abscess observed at St. Alexis Hospital.*

Sex:	Males: 11	Females: 4		
Location:				
Right Side			12	
Left Side:				
appendicitis	1			
gastric ulcer	1			
gastrojejunal ulcer	1			
	—		3	
Gas in Abscess:				
Gas and fluid level shown by x-ray examination in 7 cases.				
Etiology:				
Appendicitis			8	53%
Ruptured ulcer:				
gastric	3			
duodenal	1			
gaojejunal	1			
	—		5	
Trauma, with fractured ribs and injury to right abdomen:			1	
Unknown			1	
Complications:				
1. Spontaneous rupture:				
into pleura	1			
into bronchus	1			
into colon	1			
	—		3	
2. Abscess of the lung			2	
3. Additional subphrenic abscess			1	
4. Pelvic abscess			1	
Drainage:				
Surgical drainage			12	
Spontaneous drainage:				
through abdominal incision for appendicitis	1			
through colon	1			
	—		2	
No drainage			1	
Mortality:				
15 cases of subphrenic abscess:				
Living			10	
Dead			5	33.3%
Of the 14 cases which were drained, either by spontaneous drainage or surgical drainage, 4 are dead. Mortality:				28.5%
One case had no drainage, with fatal issue Mortality:				100%

* Five of these cases have been reported previously by Dexter.[3]

CONCLUSIONS

1. Subphrenic abscess is not an uncommon complication following surgical procedure or acute inflammatory conditions in the abdomen.

2. Proper roentgen examination, with accurate interpretation of the findings, is the most important single factor in making the diagnosis of subphrenic abscess.

3. Correlation of the roentgen findings with the clinical evidence is important and necessary in the diagnosis of most of the cases.

4. A high, fixed diaphragm is present in most of the cases but slight excursion does not rule out a subphrenic abscess.

5. Early diagnosis and proper surgical treatment will reduce the mortality rate at least 60 per cent.*

* I wish to thank Dr. Frank J. Gallagher and Dr. Richard Dexter for their interest and helpful suggestions in the preparation of this paper.

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THE ROENTGEN APPEARANCE OF THE CHEST OF THE NEW-BORN INFANT*

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WHILE much has been written about the roentgenology of the adult chest and of the infant's chest affected by disease, relatively little appears in the American or English literature concerning the appearance of the chest of the normal new-born child, the studies of DeBuys and Samuel,[2] Wasson,[6] and more recently Weymuller, Bell and Krahulik,[7] being the best known. Because of this, Dr. Ralph M. Tyson, pediatrician to the maternity wards of the Jefferson Hospital, under the direction of Dr. P. Brooke Bland, suggested that such a study would be of value. One hundred and fifty-nine infants were roentgenographed within forty-eight hours of birth, most of them within the first day. Ten days later the children were again examined and some of them again when six months of age.

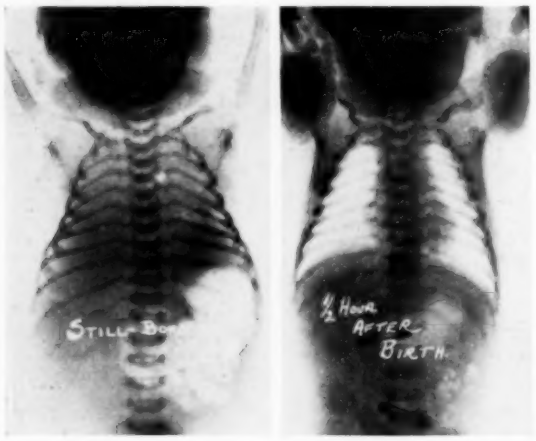

FIG. 1. Anteroposterior view of the chest of a still-born infant and of a live infant thirty minutes after birth. In the former the upper six ribs are sunken in on the unexpanded lungs, while the lower are held out by the upper abdominal structures. Air in the stomach and bronchus is due to efforts at artificial respiration. The ribs of the infant made one-half hour after birth outline a single truncated cone. The lungs are evenly expanded throughout.

* From the X-Ray Department, Jefferson Hospital, Philadelphia, Pa.

ANATOMICAL FINDINGS

The still-born, full-term infant's chest presents on the roentgenogram an even density in which the heart and airless lungs cannot be distinguished from each other or

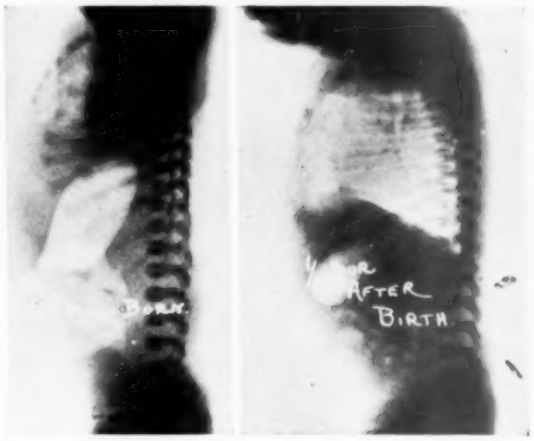

FIG. 2. Lateral view of the chest of a still-born infant and of a live infant thirty minutes after birth. In the still-born the unexpanded lungs are evenly dense, the spine is straight and the ribs are close together. In the living infant, the ribs are definitely separated though they lie more nearly at right angles to the spine than they do in the adult chest.

from the abdominal viscera (Figs. 1 and 2). The lungs are collapsed and the upper ribs, hugging them close, sink in on them in such a way that the outline of the bony thorax is seen as two truncated cones, one resting on the other. In the lateral view (Fig. 2) the same even density is presented.

With the entrance of air into the lungs, on the establishment of respiration, it becomes possible to distinguish the various organs from one another (Figs. 1 and 2). The expanded lungs requiring a greater volume than the collapsed, the upper ribs are lifted away from them and instead of two truncated cones the outline is of only

one. The heart, lungs, great vessels, and often the thymus, can be seen as independent structures because of the transparency of the lung fields.

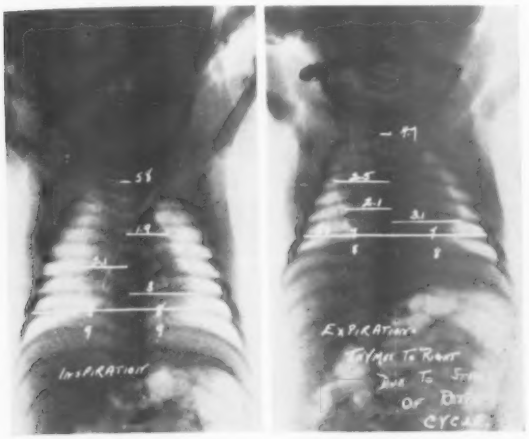

Fig. 3. Illustrating the difference in the shape of the cardiac shadow at inspiration and expiration. With expiration, the chest contracts, the diaphragm rises and the heart is lifted and swung to the side so that the area of its projected shadow is greater at expiration. In the film made at expiration, the thymus is brought into relief.

In contrast to the adult in whom the ribs curve from above downwards—the posterior portion being higher than the anterior—the ribs of the infant lie almost at right angles to the spine and circle the thorax in planes that lie in this same angle. The spine of the new-born infant is quite straight in the lateral projection, the familiar convex thoracic and concave lumbar curves of the adult being undeveloped and not pronounced. The sternum is also seen more clearly in this view because of its four and ofttimes five, separate points of origin than it is later when they have fused (Fig. 1). Another factor which leads to the ease with which the sternum is recognized is found in the shape of the chest. On cross-section at birth the thorax is practically round; the thoracic index—the percentage of the transverse diameter which the anteroposterior diameter represents at the nipple—is about 90. The lower sections, therefore, are definitely of a greater diameter than the upper, and the sternum as the most anterior portion of the skeletal framework stands out in relief.

ANTHROPOMETRIC FINDINGS

The films of 96 infants, 39 male and 57 female, of the total 159 whose chests were roentgenographed, were measured. The remaining 63 were not measured because they were not true anteroposterior exposures made with the infant lying evenly on his back with the spine straight. In the discarded films the infant had managed to turn so that the shadow was distorted.

The width of the chest was determined by measuring a line drawn at right angles to the spine through the highest point of the diaphragm. The internal measurement was recorded; that is, the distance from the inner side of the ribs through which the line passed on the two sides. For the

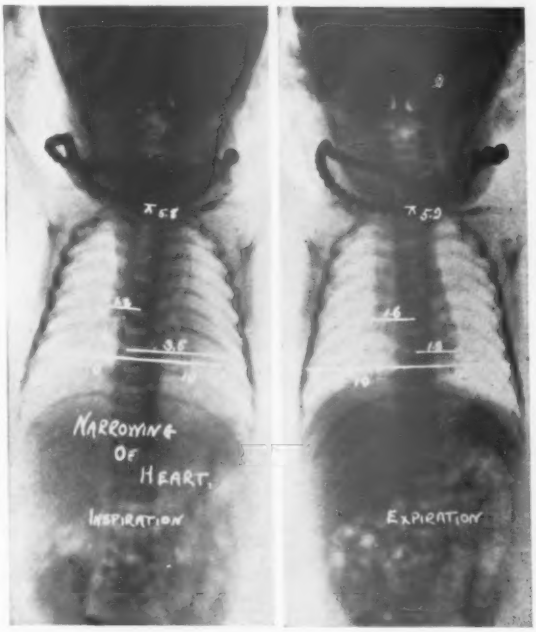

Fig. 4. Long narrow heart. Though the chest narrows with expiration in the crying child, the narrowed glottic chink offers such resistance to the egress of air that the heart is swung on its long axis and its projection on the chest wall made smaller until the last instant in the crying cycle when for a moment it is made larger as in quiet expiration.

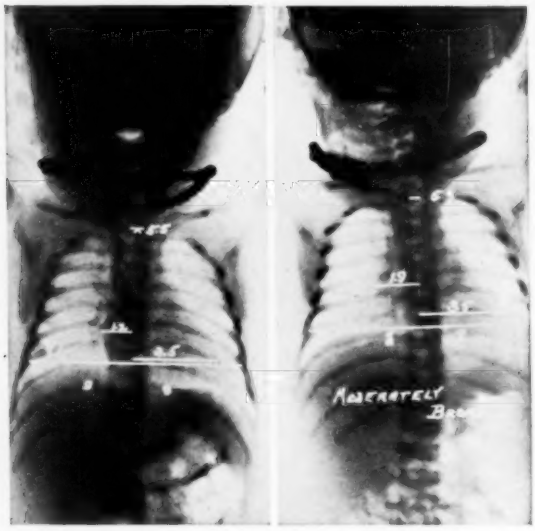

Fig. 5. Heart with broad apex and narrow base.

length a second line was drawn through the center of the spine at right angles to this first line, and the distance from the diaphragmatic line to the upper border of the first rib recorded as the length (Figs. 3 to 14).

The average thoracic width for all babies was 9 cm.; the males were slightly larger than the females, the width in the former averaging 9.1 cm., and in the latter 8.9 cm. The average length was 5 cm., the males again being slightly larger with a mean of 5.1 cm., while that for the females was 4.9 cm.

These findings are in keeping with the usually accepted birth-weight figures in that the average weight of male infants is greater than that of the females.

Cardiac measurements were obtained from films made at inspiration. Manges[3] has demonstrated in his work on foreign bodies in the air passages that the respiratory cycle and the crying effort definitely influence the size of the heart. With normal quiet breathing the thoracic cavity grows smaller and the diaphragm rises as the air is gradually expelled during the expiratory phase. As the thoracic cavity diminishes in length with the rising diaphragm, the heart is lifted and tilted so that the apex is swung farther to the left and the base farther to the right. The transverse diameter of the heart therefore increases during this phase, and the projected cardiac shadow occupies a proportionately greater area at expiration than it does at inspiration (Fig. 3). Manges showed that the reverse of this is true as far as the heart shadow is concerned during the forced expiration incidental to the crying effort. The narrowed glottic chink offers a decided resistance to the egress of the air as the infant forcibly contracts the chest to increase the volume of sound; the intrapulmonary pressure is raised as a result, and the heart swings on its long axis, the apex coming forward, the base backward. Its narrower diameter is, therefore, presented; the projected area is lessened for the greater part of this phase and is only broad for a moment at the extreme end of expiration (Fig. 4). In the crying child, unless one makes the exposure at this final instant of expiration, he will find that the transverse cardiac diameter is less than it is at inspiration even though the chest has narrowed and the diaphragm has risen.

The transverse diameter of the heart was determined by measuring the distance it extended to the right and left by lines

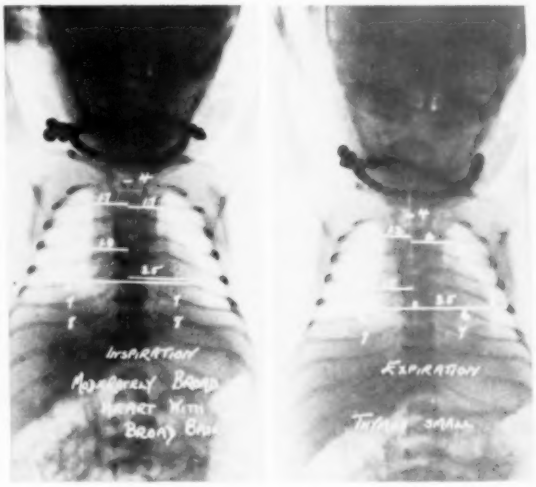

Fig. 6. Heart with broad apex and broad base.

drawn at right angles to the spine (Figs. 3 to 14). In both the male and female infants the width of the cardiac shadow was the same, 5 cm.; its average extension to the right was 1.8 cm. and to the left 3.2 cm. The ratio of the transverse diameter of the heart to that of the chest was in the males as 5:9.1, and in the females as 5:8.9; therefore, the cardio-thoracic index—the relation of the heart diameter to the chest diameter—was 0.55, which is but 0.05 greater than that looked upon as normal for the adult. The ratio of the width of the right side of the cardiac shadow is roughly as 1:3, while that of the left side is as 1:1.5. These figures show the right side as representing on the average about one-third of the total width, a proportion that is greater than that exhibited by the corresponding portion of the organ at maturity.

The heart has been described as being of a great variety of shapes by other observers. Thus, in a similar study DeBuys and Samuel[2] classify them as globular, adult, drop, nutmeg, square, round and unusual. In the present study four distinct conformations were noted in the hearts: (1) the long narrow (Fig. 4); (2) the broad apical with narrow base (Fig. 5); (3) the broad apical with broad base (Fig. 6), and (4) the round globular (Fig. 7). The middle two groups included the great majority, but there is a striking difference within these limits as shown in Figures 4 and 7. Figure 4 is of a chest in which a long narrow heart occupies but little space in the chest, while in Figure 7, the heart almost fills the chest and yet is organically and functionally normal.

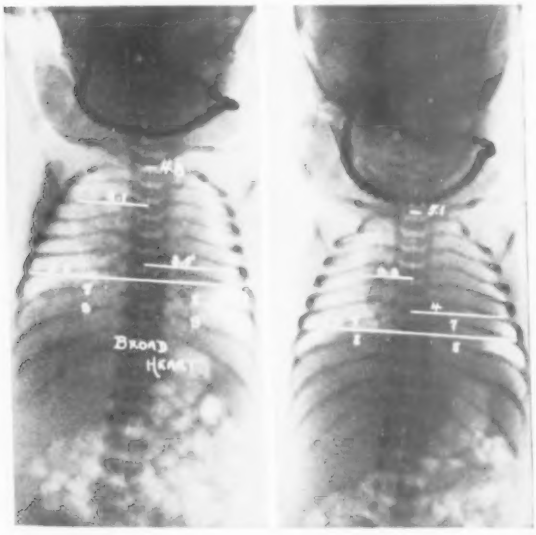

Fig. 7. The round globular heart.

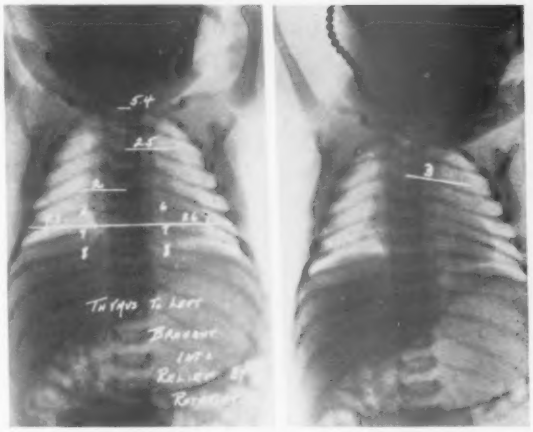

Fig. 8. Thymus brought into relief by change of position.

THE THYMUS

In 30 instances in the 96 measured chests the thymus was seen, a little less than one-third of the cases. It was brought out in other infants by changes in position, by varying stages of the respiratory cycle or by rotation of the infant (Figs. 3 and 8).

Coplin's[1] classification, based as it is on post-mortem examinations, is probably the most acceptable. He recognizes four types: the unilobar, the bilobar, the trilobar and the conglomerate. The third, the trilobar, was the most common in his series. Noback[4] who accepts Coplin's classification as the most practical, found the bilobar the most frequent. The trilobar thymus is one in which there are two inferior and lateral masses, and a single median and superior lobe. In the necropsy observations of Noback, one finds the factors which determine the visibility of the gland. Lobation, he found, was determined early in fetal life; in the embryo the thymus is cervical,

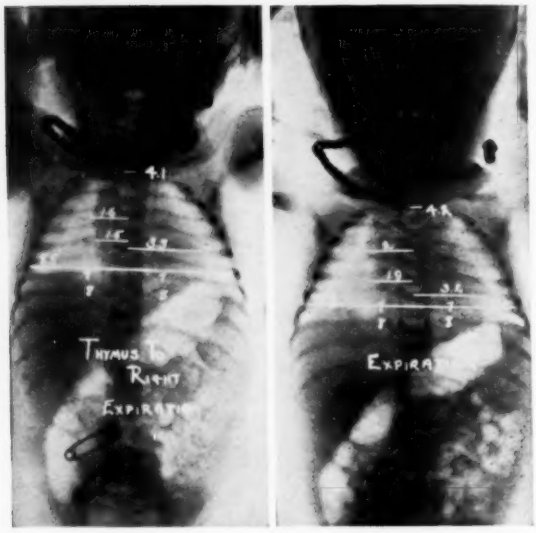

Fig. 9. Thymus brought into relief during the expiratory phase of the respiratory cycle.

while in the older infant it is thoracic. In the late fetus and in the new-born, it is usually of the cervico-thoracic type, that is, it lies between the cervical position of the embryo and the thoracic position of the older child, and its forms and relations are quite constant. Its lateral surfaces then are convex and bulge against the medial surfaces of the lungs, the lungs rarely touch its anterior surface. The thymus rarely extends to the anterior surface of the right ventricle. At this time the thymus is

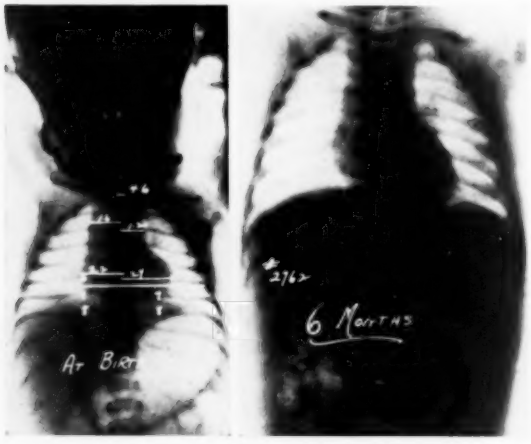

Fig. 10. Broad apex, narrow base type of heart at birth and at the end of six months.

essentially a broad organ. With the onset of respiration, pressure of the surrounding structures changes its outline. The lungs press upon it from either side, the space which it occupies in the superior mediastinum is narrowed in the anteroposterior plane by breathing, and as a consequence, it is forced down over the heart, most frequently over the right ventricle. In other words, it changes from the broad to the narrow elongated variety.

These anatomical facts explain in some measure the symptoms attributed to the thymus; for in an attempt to pass from the embryonic cervical position, it may exert pressure on the structures behind it, and thereby interfere with respiratory or cir-

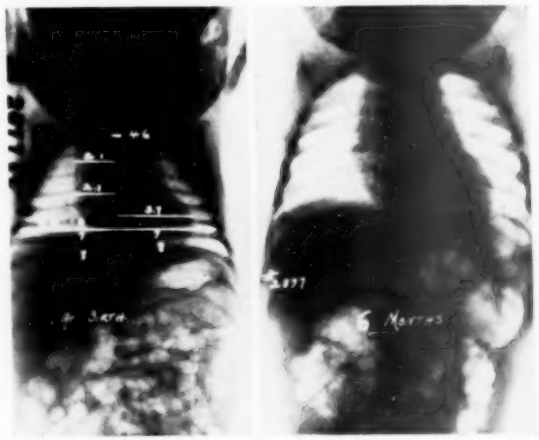

Fig. 11. Broad apex, broad base type of heart at birth and at the end of six months.

culatory function. A large thymus, simply because of the space it requires, may similarly press on the underlying organs, the trachea, main bronchi, or the great vessels.

The respiratory movements often determine the demonstration of the thymus. With deep inspiration the gland may be hidden by the mediastinal structures; but on expiration, due to the diminution of the space which it occupies and the fact that it cannot be appreciably compressed, the thymus is forced down over the heart and out over the lung fields. It is then recogniz-

able even though it was not seen before (Fig. 9).

In a study of pulmonary motion, Walsh[5] found that in the adult lungs the apical alveoli showed a greater degree of distention than the more basal, while in the newborn infant, the alveoli were of the same size throughout. Champney has said that the margins are the portions which at postmortem show the least expansion. Atelectatic areas were not found in this study even at the bases which Walsh demonstrated to be the least active portions, and consequently the area in which one would expect to find it. This is in keeping with the experience of Weymuller, Bell and Krahulik[7] who found only one infant in twenty-five

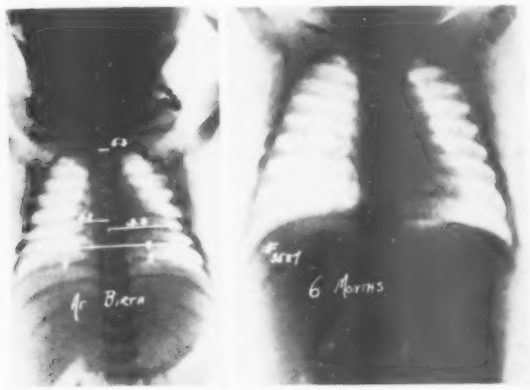

Fig. 12. Broad apex, broad base type of heart at birth and at the end of six months.

who showed anything suggesting atelectasis, and, in this instance, the shadow disappeared in twenty-four hours. None of the babies was roentgenographed in less than fifteen minutes after birth, and in all of them, the lungs were roentgenographically fully expanded. The lateral margins are usually hidden by the overlying denser organs, the sternum, heart and mediastinal structures in the midline. The lower margins and bases are obscured by the diaphragm. These factors definitely interfere with the visibility of these areas.

Practically all the infants were again roentgenographed at ten days of age. Study and measurement of these films demonstrated that no appreciable change takes place in the contour of the chest or heart in this time.

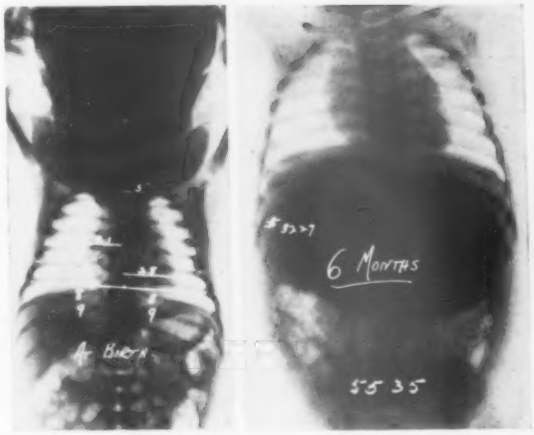

Fig. 13. Broad apex, broad base type of heart at birth and at the end of six months.

It was possible to restudy some of the infants after a lapse of six months. In these, the most striking finding was the similarity in the configuration of the thorax and thoracic organs to that seen in the same infant at birth (Figs. 10, 11, 12, 13 and 14). Those infants whose early studies presented a long narrow chest with a long narrow heart showed the same type of chest and heart on a subsequent examination; and those in whom the large globular hearts were seen in their first studies

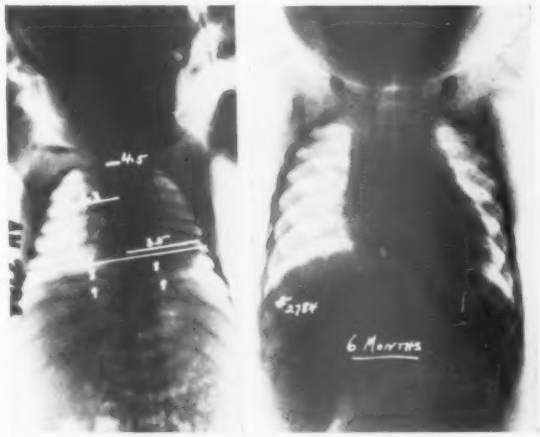

Fig. 14. Round globular heart at birth and at the end of six months.

presented a very similar cardiac outline in the later roentgenogram. This finding was also true in the two intermediate groups, those with the broad apical and narrow basal outlines, and in those with broad apices and broad bases.

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Vol. XXIV, No. 2

THE DEVELOPMENT OF MARBLE BONES*

By A. HOWARD PIRIE
MONTREAL, CANADA

ALBERS-SCHÖNBERG first described the condition known as marble bones in 1904. Before this Society in 1923 Dr. William G. Alexander reported a case and at that time 7 cases had been reported in Germany and 2 in America. In 1926 Bernhardt stated that 16 cases had been reported. From 1926 to 1928 I have found reports of 10 other cases. So that to date 26 cases have been reported.

To this number I wish to add 4 cases from one family and one independent case. The 4 cases in one family consist of a mother, with fully developed marble bones, and her three children (a boy and two girls) with developing marble bones.

The fully developed case to be described differs little from cases already reported. The patient was carefully studied as to all systems, blood examinations and usual laboratory tests. She suffered from one fracture only. She had diabetes and died six years after the recognition of the marble-bone condition. The calcium content of her blood was normal at two examinations. The bones show the typical appearance of marble bones. One roentgenogram showed a fetus and a fracture. I showed a slide of this to the Society five years ago and suggested that the fetus, from the density of its vertebrae, was a case of marble bones in utero. It is the follow-up of this fetus now a boy of six, and his two sisters, all of whom show early stages of marble bones, that has prompted this paper. Besides these 3 cases—all the children of a mother with marble bones—I have another typical early case from another family. The ages of these 4 cases are five, eight, eleven and fourteen years, and one can trace the increase in the marble-bone condition as the ages advance. The three children of the mother with marble bones have been completely examined roentgenologically at intervals of twenty-one months. At first examination they presented the following characteristics:

CASE I. Donat, aged five. Intelligent boy, teeth good except for two decayed molars; not anemic, spleen and liver not palpable. He

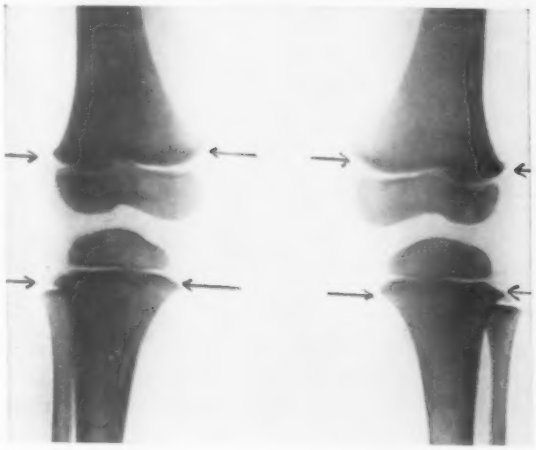

FIG. 1. Case I. Boy, aged five. Note the dense line 0.5 cm. broad at the lower end of the diaphysis of the femur and the upper end of the diaphysis of the tibia. This is the earliest appearance of marble bones.

showed a dense band at the lower end of the diaphysis of the femurs and upper end of tibia and upper end of humerus. Otherwise he showed no evidence of commencing marble bones (Fig. 1).

CASE II. Louisette, aged eight. Female, intelligent, not anemic, three decayed teeth, spleen and liver not palpable, slightly underdeveloped. Roentgen examination showed broad bands at the ends of most of the diaphyses of the long bones and circular shadows in the carpal bones (Fig. 2).

CASE III. Lucette, aged eleven. Female, not undersized, intelligent, slightly anemic, several teeth extracted, remaining teeth good, liver and spleen not palpable. The diaphyses of the long bones showed broad, well-marked bands

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

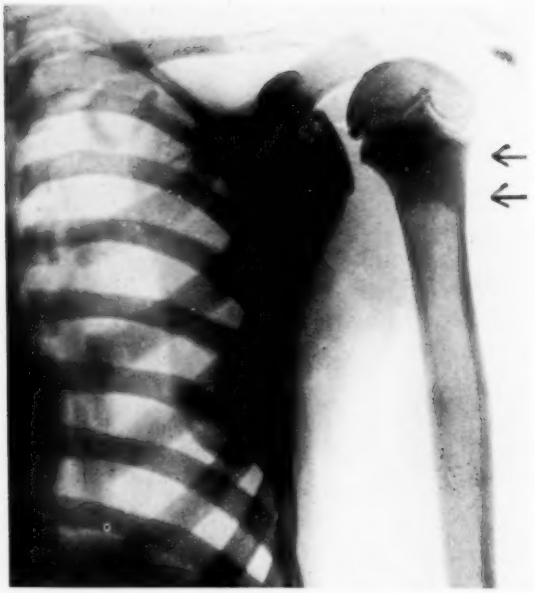

Fig. 2. Case II. Girl, aged eight. Shows a much broader dense area (2 cm.) at the upper end of the diaphysis of the humerus.

and the carpal bones showed ring shadows. The tarsal bones showed slight ring shadows but not well marked. The iliac bones showed ring shadows. The base of the skull was slightly thickened. The sella turcica was normal (Fig. 3).

Case IV. F. L., aged fourteen, female. The following notes were sent by Dr. H. H. Farris of St. John County Hospital. Family history, mother dead; she had no sisters; the father was examined and nothing unusual found. The only living female relative is an aunt. No information regarding her. Calcium balance was not determined. No history of endocrine distress, including diabetes. There is no history of spontaneous or other fracture. She died at the age of fifteen from pulmonary tuberculosis. There were no other symptoms intervening. The bones of the knee joint were excised and are described later (Fig. 4).

In the next stage of the disease there is an advance of the clubbing of the long bones and an extension of the marble process into the epiphyses. In my earlier cases the epiphyses were very little affected, but in the latest film of my oldest case the epiphyses are dense.

Roentgen examination of the three related children twenty-one months later showed that in each case the marble condition of the bones had increased. In each case the extension in the long bones had gone farther into the medulla. This extension is not due to formation at the epiphyseal line, but evidently the process starts there and goes on extending through the bones. The extension was greater in the girl of eleven than in the other children and brought her condition nearly up to the fully developed stage of marble bones. Along with this a moderate degree of anemia was noticeable due to the encroachment on the medulla of the bones.

Case V. Mrs. D., Nov. 24, 1927. Five children, 2 living, oldest fifteen, youngest five; 3 dead, two boys (twins) died at eight days.

Diabetes mellitus, two years' duration; liver and spleen not enlarged.

Family History. Father died of diabetes at the age of forty-nine; mother died at the age of eighty-six. Brother and sister died of diabetes.

Blood Examinations: Wassermann reaction

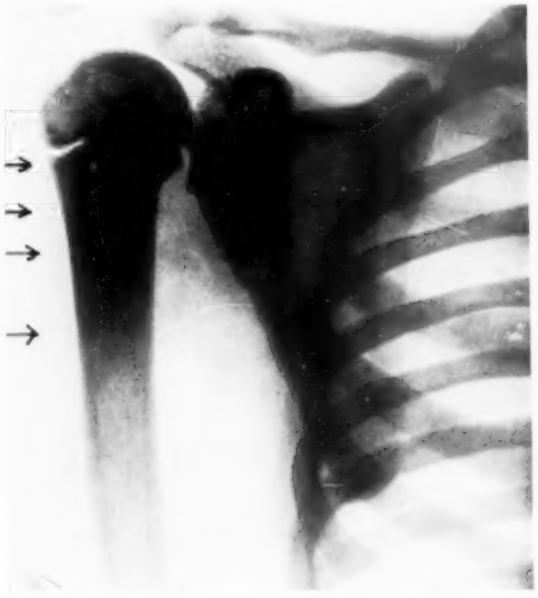

Fig. 3. Case III. Girl, aged eleven. Shows a still broader dense area (6 cm.) at the upper end of the diaphysis of the humerus. A year later this band had broadened to 10 cm.

negative. Red blood count, 5,100,000; white blood count, 7,000; Hb, 77 per cent. The conclusions from a complete blood examination were that there was no suggestion of any leucemic process; there was a mild anemia due to lowered hemoglobin concentration and small cells. Calcium in the blood normal on two examinations.

The roentgen examination showed typical appearance of marble bones affecting all the bones of the body.

In the Proceedings of the staff meetings of the Mayo Clinic, Dr. Bonta says in relation to marble bones, "It was noted by one surgeon on attempting to repair a fracture that the density of the bone was so increased that insertion of a drill was very difficult," and in the discussion following, Dr. M. S. Henderson states, "In the cases operated on the bones are so hard that they break the edge of the chisel or the drills." With a view to testing this, I drilled a normal femur 8 inches from the knee joint and a corresponding thickness of marble bone at the lower end of the diaphysis of the femur, picking out the densest part I could find. I exerted as nearly as I could the same pressure in each case. It took 23 turns of the handle of the drill to get through the normal bone and only 7 turns to get through the marble bone. The feeling caused by the cutting edge of the drill was very different in the two operations. With the normal bone the drill cut with a charp cutting sound, but in the marble it sank in as if boring into chalk. This explains why fractures are so common in cases of so-called marble bones. On using my pen knife on the marble bone I found it cut like chalk and not at all like marble, and I felt inclined to call them chalky bones and not marble bones. Albers-Schönberg named the condition marble bones from the roentgen appearance. If he had cut into the bone I doubt if he would have described it as marble. Figure 5 shows a roentgenogram of a piece of chalk and a piece of marble and each casts a similar shadow. The shadow of the marble is slightly denser than the chalk. If Albers-Schönberg had introduced the term chalky bones instead of marble bones, one would have been led to expect fractures and yet the roentgen shadow caused by marble and chalk are much the same as both are mainly calcium carbonate. In support of this I may quote the autopsy findings of Prof. Hart (quoted by Schulze) in which he says "in the medullary spaces chalk masses have been deposited."

A characteristic feature in adult cases of

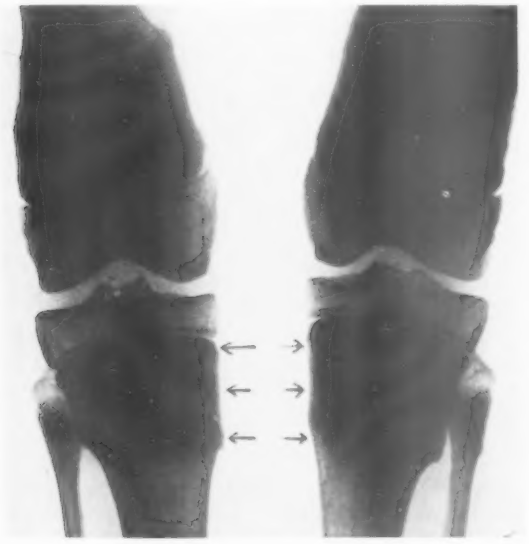

Fig. 4. Case IV. Girl, aged fourteen. The clubbing of the femur and tibia is evident and shows a more advanced stage than do Figures 1, 2 and 3. The "marble" portion measures 10 cm. in one femur and 8 cm. in the other.

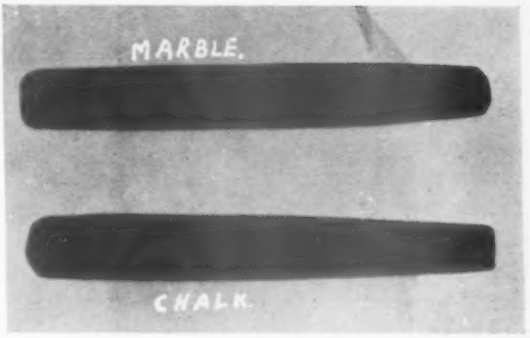

Fig. 5. Roentgenogram of a piece of chalk and a piece of marble.

marble bones is that not all the bones at all points develop the marble appearance. For instance, in my own adult case the upper end of the fibula appeared normal while the rest of the fibula had the marble appearance. Again, the commencement of the process is most evident where healing rickets is most evident, viz., at the ends of the diaphyses. In one of my early cases the condition in the upper end of one tibia was more advanced than that of the other. This irregular distribution which has been noted by other observers seems characteristic and leads me to suggest that the condition is a widespread infection which begins at the epiphyseal line and later spreads to the whole medulla. In the late stage of the disease when the medulla of all the bones is affected there are great changes in the blood. If the condition were an endocrine disturbance one would expect a complete bone picture with no gaps, and yet the gaps appear in most of the cases reported. The gross specimen shows dense bone in the metaphysis. In this dense bone are seen transverse lines of growth suggesting that the dense bone was laid down at the epiphysis and was never removed. This is not the only place it is laid down for two lines of dense bone are seen extending longitudinally up the medulla, and on the surface are lines extending longitudinally. These, however, may have been formed at the epiphysis. They make the outside of the bones fluted like a corinthian pillar. The epiphyseal line is irregularly broad and narrow. The epiphysis is spongy but has condensed marble-like bone at its articular surface. The tibia and femur are alike in these respects on each side of the knee joint. Another characteristic of developing marble bones is the ring shadows of the carpal bones. It is best seen in the scaphoid and consists of a condensed ring of bone at the periphery. This condensed ring is also seen in the epiphyses of the long bones. A characteristic feature described by certain German writers is the fractures found in marble bones of young people. None of my young cases showed any fracture and my adult case had only one fracture. The fractures take place in the bone where it has developed its full marble appearance and it is easy to understand why the fractures occur when you know the bone has grown chalky in consistence and has no resemblance to marble except that it casts a shadow like marble. The transverse lines in developing marble bone at the ends of the diaphyses resemble the condensed lines of growth caused by illness as seen in many young bones and so the condition of marble bones represents the result of a continuous illness. From microscopic study it seems to be a calcification of the cartilage at the epiphyseal line and this calcification is not removed, giving rise to the chalky condition of the bone which has been known up to the present as marble bones.

I am indebted to Prof. Waugh, pathologist of McGill University, for the following report on the fourteen year old case of marble bones (Case IV).

Knee Joint. Specimen consists of the lower end of the left femur and upper ends of tibia and fibula, the ligaments of the knee joint being in their normal positions. The outer surface of the femur and tibia near the joint ligaments show a distinct irregularity in the form of longitudinally arranged columns.

The cut surface of the specimen shows the epiphyses ununited (normal) and consisting of relatively normal appearing cancellous bone except just beneath the articular cartilages where it is more solid in appearance.

The epiphyseo-diaphyseal lines are cartilaginous and irregular, varying considerably in thickness from 1 to 5 mm. They consist of a fine whitish opaque zone on the epiphyseal side 1 mm. in thickness and a bluish-gray transparent area on the diaphyseal side which varies in thickness up to 4 mm. The diaphyses of all three bones show the normal cancellous end portion to be replaced by comparatively solid tissue in which there are definite column-

like formations running in the longitudinal axes of the bones. Beyond these areas the shaft of the bones is composed of relatively normal appearing outer cortex and inner cancellous area. Nevertheless, even here in the cancellous tissue there is a central, more compact appearing zone and evidence of extension of the column formation described above.

Microscopic Examination. Section taken so as to include epiphysis, epiphyseo-diaphyseal line and diaphysis presents the following picture: the epiphysis shows relatively normal appearing cancellous bone composed of spicules with very little enclosed cartilage. Between the spicules there is a large amount of relatively hemorrhagic myeloid tissue containing considerable fibrillar matrix. As one approaches the epiphyseo-diaphyseal line there are greater inclusions of cartilage in the bony spicules. The line varies considerably in thickness, showing a firmer, lighter staining, more compact area of cartilage towards the epiphysis and a more cellular cartilaginous zone which varies considerably in thickness towards the diaphysis. The histological structure of the diaphysis is distinctly different from that of the epiphysis. It impresses one as being fundamentally calcified cartilage in which are smaller and larger irregular open spaces. These open areas compose less than 25 per cent of the total structure and are lined by irregular masses of bony tissue. Scattered throughout the calcified cartilaginous material are innumerable small spherical foci of ossification completely surrounded by it so that no open space is present. This arrangement persists well out to the periosteum though there is present a narrow irregular zone of subperiosteal compact bone. Compared with the epiphysis the diaphysis is here much less vascular. The open spaces contain rather cellular, irregular, fibroblastic strands, but few typical myeloid cells. Flattened osteoblasts are conspicuous about the lining of the spaces, but typical osteoclasts are comparatively rare.

Beyond the end of the bone as one enters the shaft the ossification is much more complete, the open spaces are much larger and myeloid cells are found in them. Even here, nevertheless, there is an abnormal amount of cartilage in the bony spicules and there is a relatively large amount of osteoid tissue. Here a definite zone of compact bone of considerable thickness is present beneath the periosteum.

Anatomical Summary: Albers-Schönberg's disease (marble bones).

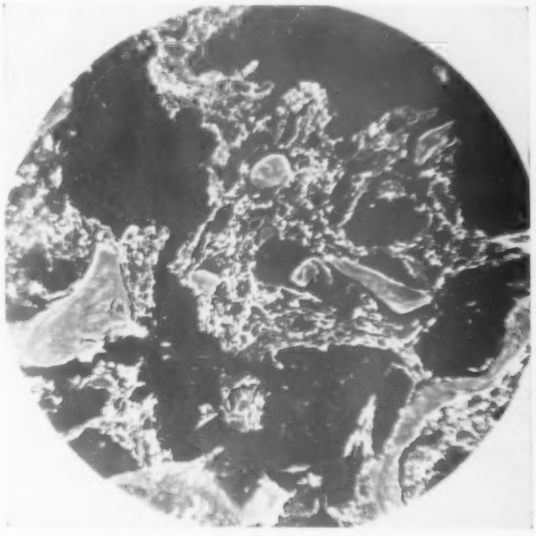

Fig. 6. Section of the normal bone of the epiphysis from Case IV showing spicules of true bone and myeloid tissue (low power).

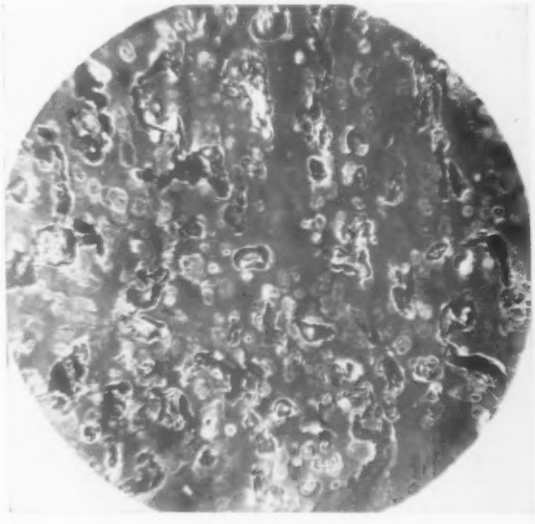

Fig. 7. Section of true marble bone from Case IV. The appearance is that of calcified cartilage, with irregular myeloid spaces (low power).

A specimen of a dense piece of marble bone from Case IV was analyzed for calcium content and the result showed

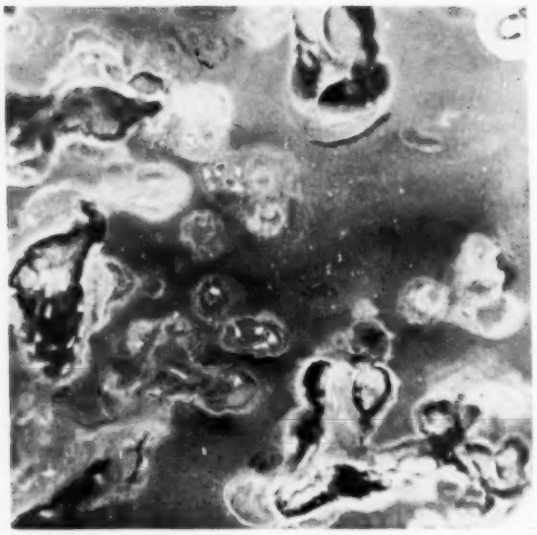

FIG. 8. Same as Figure 7 showing flattened osteoblasts and areas of ossification (high power).

Ca 29.2 per cent, the normal for bone being 28 to 29 per cent Ca. These figures are by weight; by volume the Ca is of course much increased.

SUMMARY

1. The condition known as marble bones begins to develop at the ends of the diaphysis, and extension into the shaft occurs at or after puberty.

2. The earliest stage of development is best seen at the lower end of the diaphysis of the femur and upper end of the diaphysis of the tibia and humerus.

3. The ring shadows of the carpal bones and iliac bones are early indications of marble bones elsewhere.

4. Marble bones resemble marble only in their roentgenographic appearance. The actual bones are more like chalk in consistance and therefore fracture easily. The term "chalky bones" rather than "marble bones" would better describe the condition.

5. In 4 early cases at the ages of five, eight, eleven, and fourteen, the band of marble bone at the end of a diaphysis was found to be respectively 0.5, 2, 6 and 10 cm. broad.

6. Infection rather than an endocrine cause is suggested for the production of the condition.

7. Complete marbling of all the bones does not occur until puberty.

8. Perfect marble condition of all bones is not consistent with life as it means destruction of the medulla of the bones. Therefore in every case some bone or part of a bone does not show the marble condition.

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DISCUSSION

Dr. Ralph S. Bromer, Philadelphia. I would like to ask Dr. Pirie whether he knows of any alteration or peculiarity of diet in the previous history of these cases. Dr. Pancoast has told me that he has observed a case of overfeeding of irradiated cod-liver oil. This overfeeding resulted in a very dense and comparatively speedy bone formation. In other words instead of the usual dense appearance of the bones in healed rickets, an overproduction of dense bone was obtained and it was recommended that the feeding of the irradiated cod-liver oil be discontinued. Possibly too much of one vitamin factor in the diet might be a contributory cause of this disease. If the blood calcium in these cases was high and if the calcium content of the bones, analyzed after autopsy was high, I should think that possibly the diet factor might considered in the etiology of the condition.

Dr. Leon T. LeWald, New York City. I wanted to ask Dr. Pirie if he thought there was any relation between Paget's disease and this condition. One author in reporting some cases of marble bones thought that the marble bone condition was related to the peculiar changes we see in Paget's disease Personally I do not feel that there is any relation at all between these two conditions.

I wish Dr. Pirie would also say a word as to his idea of the etiology of marble bones. The thing that strikes me as most interesting is the occurrence in a family. If it is a peculiar condition due to some metabolic condition, I do not see why it would not occur in separate individuals rather than in families.

Dr. Pirie (closing). Dr. Bromer's remarks about diet and blood calcium and calcium content of the bone I can answer to a certain extent. I think that diet can have very little to do with it because these children were treated just as other children. They went to school, and as far as I could find out, they were normal. They were fairly intelligent children, slightly under-developed: the oldest one was beginning to get slightly anemic from the amount of involvement of the medulla of the bone. The blood calcium was twice investigated in the mother with fully developed marble bones, and we found it normal in both examinations.

I know the Germans have described an increase of blood calcium. It is what one would expect, but our results on two occasions gave no increase in the blood calcium. I had a piece of this marble bone analyzed and found that in weight the calcium was normal and corresponded with normal bone; normal bone is 28 to 29 per cent, this marble bone was 29.2 per cent.

The relation of this to Paget's disease, arises I think from the strained way in which the Germans tried to find marble bones after Albers-Schönberg first described them. If you read some of the early cases described as marble bones, I think you will agree with me that they aren't marble bones at all; they don't compare with our findings here anyway.

With regard to the etiology, rickets appears very much as a first cousin of marble bones. I can't say what the etiology is, but it certainly is closely allied to rickets from the way that it develops.

With regard to the lung question, I cannot go into that as it is quite a different subject from marble bones.

THE UNCOILED AORTA

PART II. THE PATHOLOGIC AORTA*

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HERETOFORE, a discussion of the pathologic aorta has been concerned principally with a consideration of two volumetric changes, namely, dilatation and aneurysm. With the latter, I am not here concerned since little difficulty is experienced by the well-trained roentgenologist in its recognition. But the determination of the former does present many difficulties. Moreover, the estimation of the aortic caliber is only a portion of the information that the roentgen examination is able to impart. It is proposed that the type of uncoiling be employed as an aid in the determination of pathologic changes in the aorta.

In Part I† an attempt was made to establish the normal type of aortic uncoiling, and the technique for its determination was described. I shall now apply this method to a consideration of the four major types of heart and aortic disease.

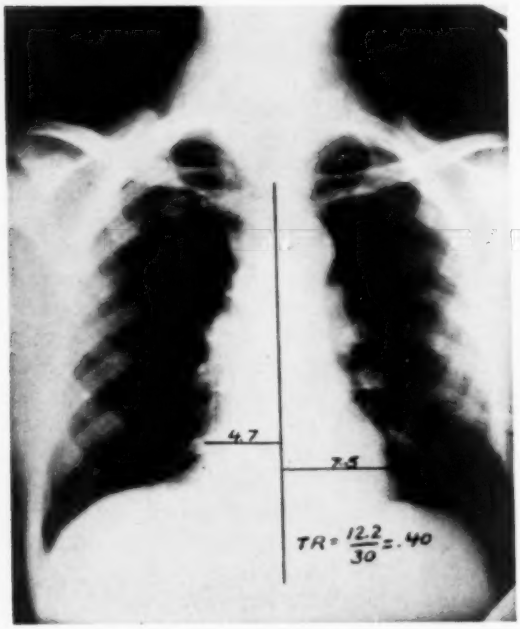

FIG. *1a*. Arteriosclerotic type of aorta. Teleroentgenogram of the chest of a patient, aged fifty-eight; blood pressure, 140/70; Wassermann reaction, negative; systolic murmur over the aortic area and no failure. Note the elongation and tortuosity (lordosis) at the base of the supracardiac shadow just above the right auricle, the absence of cardiac enlargement, and obliquely flattened left ventricular contour.

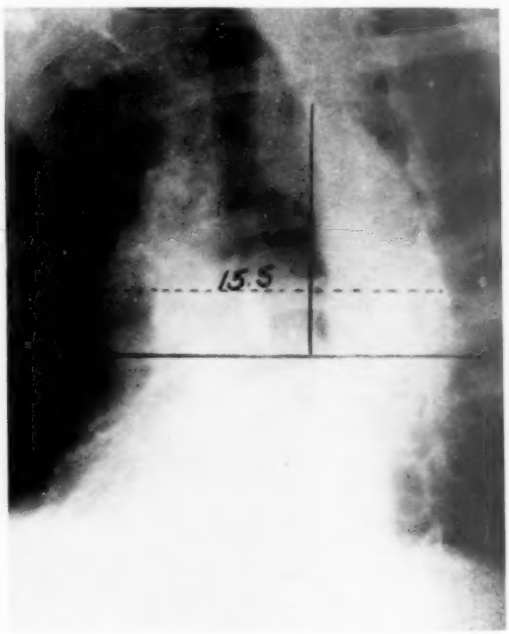

FIG. *1b*. Left anterior-oblique view. Note the elongation and separation of the arch limbs, and the tortuosity. Compare this type of uncoiling with that noted in Figures 8, 9 and 10, Part I.

ARTERIOSCLEROSIS

The following observations of Aschoff[2] on the structure of the aorta at different

† Published in April, 1930, number of the Journal, p. 358.

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

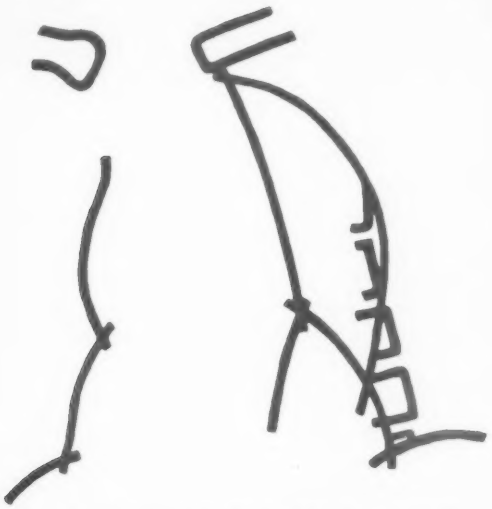

Fig. 1c. Diagrammatic outline of Figure 1b.

age periods seem essential to an understanding of the roentgen manifestation of the arteriosclerotic aorta:

We must differentiate between an ascending period, a summit, and a descending period in the life of the vessel. The first is characterized by an equal increase of all the tissue elements of the vessel wall. In the second, the artery retains its form more or less. In the third there commences the progressive dilatation of the vessel which increases with age, and which we term [senile ectasis]. The ascending period in the life of the vessel ends with the thirty-third year; the summit from then to the forty-fifth year, which marks the commencement of the descending period. *Senile ectasis is a disease of old age which no living individual escapes.* The vessel becomes overstretched, not only in the transverse but in the longitudinal diameter as well, and so arise the characteristic widenings and tortuosities of the vessel. . . . . This senile overstretching physically can be attributed to a diminution in elasticity. As you know, in young individuals, and in adults in their early twenties, the aorta is under considerable elastic tension. If one frees the aorta from the vertebral column in such a manner that it is fixed only at its upper and lower ends, and then severs it in the middle, the cut ends will retract several centimeters. This is the best proof of the existing longitudinal tension. If one repeats the same experiment in adults of sixty or seventy, the edges do not move at all, or only very slightly. The great elasticity of the aorta is therefore entirely lost in the course of a lifetime. On the other hand, in old age there is apparently a marked increase in the elastic resistance. While the isolated aorta of a thirty year old adult can easily be stretched several centimeters, it is practically impossible to do this with the aorta of an individual in his sixth or seventh decade. Wherein lies the loss of this perfect elasticity and this striking increase of elastic resistance? The loss of perfect elasticity must be dependent on a physical alteration of the elastic tissue of the vessel. It is due to the change which the elastin undergoes with age, a phenomenon which is manifest wherever there is elastic tissue, in the bronchi, the skin, etc. The overstretching of the vessels under the continuous load of the circulating blood would probably be much greater were it not for the fact that the intima of the aorta in particular, under constant longitudinal tension, becomes with increasing age, invaded with more and more connective tissue. This connective tissue possesses very slight elasticity, but has, on the other hand, a great elastic resistance. This explains the fact that the strength of the vessel wall remains almost the same or even increased in spite of the progressive overstretching which it undergoes. It is the uniform thickening of the entire intima with connective tissue that is responsible for this. Here lies the explanation of a certain rigidity of the vascular tube which may be termed *simple* or *senile* sclerosis, which has, however, nothing to do with the condition generally referred to as *atherosclerosis* or *destructive sclerosis.*

In uncomplicated arteriosclerotic heart disease the blood pressure is comparatively low. This is in keeping with the observations of Allbutt[1] on decrescent sclerosis. A knowledge of the mechanical effects of such blood pressure on an aorta with altered elasticity will still further clarify our conceptions. This can be understood when considered along with the findings of McWilliam and Mackie.[5] They have noted that the elasticity of a vessel in a state of contraction is different from that in relaxation. A strongly contracted vessel requires a pressure far above normal (several hundred millimeters of mercury)

Fig. 2*a*. Left anterior-oblique roentgenogram of a patient, aged forty-seven, demonstrating the relation of the aortic arch and pulmonary artery. The latter crosses the mediastinal space caudal to the former.

for maximum distensibility, while a relaxed or feebly contracted vessel shows this at low pressures. The level of maximum distensibility depends on muscular contraction. A contracted artery relaxes at 50° to 55° C., this temperature causing no change in a relaxed vessel. An artery which elongates 30 per cent in a relaxed condition (induced by keeping body at room temperature), by a rise from 0 to 150 mm. Hg may show only 3 to 4 per cent elongation in a strongly contracted state; hence, the elongation and tortuosity of relaxed vessels noted in the aged.

Bearing these facts in mind, the peculiar roentgen appearance of the uncoiling in sclerosis of the aorta can be clearly understood.

Fig. 2*b*. Diagrammatic outline of Figure 2*a*.

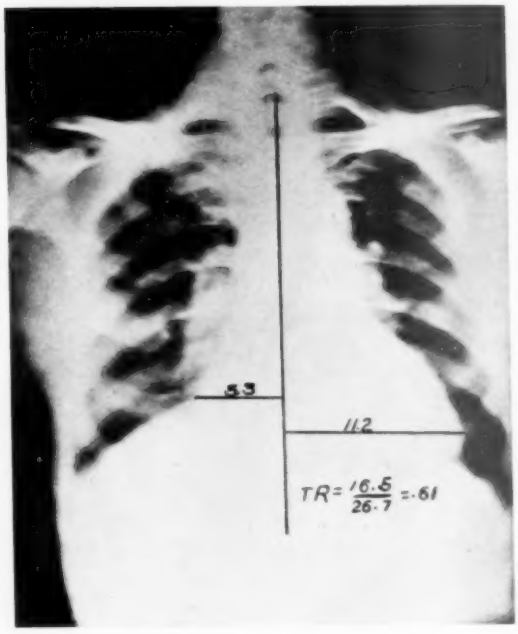

Fig. 3*a*. Syphilitic aortitis. Teleroentgenogram of the chest of a patient, aged sixty; blood pressure, 216/60; Wassermann reaction, 4 plus; aortic regurgitation, and able to carry on but a limited amount of work. Note enlargement of the heart with slightly oblique and exaggerated convexity of the left ventricular arc, the absence of a convexity at the base of the supracardiac shadow on the right and the obliteration of the aortic knob. The latter is due to the uncoiling of the aorta.

In Figures 1*a*, 1*b*, and 1*c*, 6*a*, 6*b*, and 6*c*, in the frontal views may be noted distinct elongation and tortuosity. There is a

marked convexity at the base of the supracardiac shadow to the right just above the right auricle. This is likened to lordosis of the spine. In sclerosis of the aorta as we have stated, there is lengthening as well as distention. But this distention meets with an opposing force at the superior and inferior portions of the costal cage. Hence, in order to lengthen between these two points, the aortic tube must assume a curved shape. A similar convexity is noted in the descending aorta to the left of the supracardiac shadow.

In the left anterior-oblique view, the

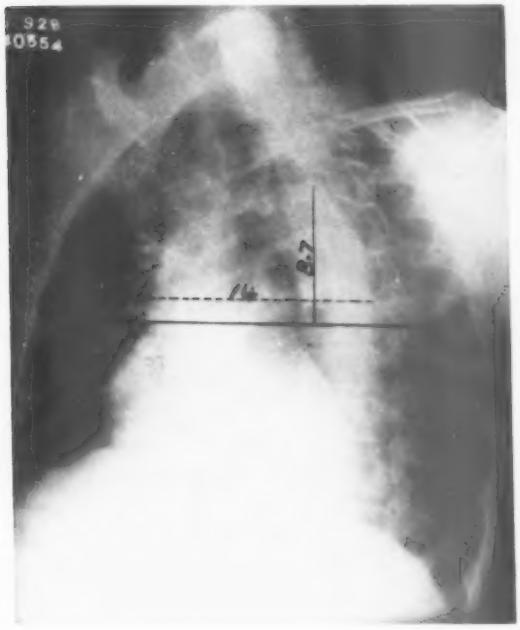

Fig. 3*b*. Left anterior-oblique view. The aorta is moderately uncoiled.

elevation and separation of the limbs of the arch are plainly visible. The tortuosity as expressed in the various convexities is readily appreciated. Recalling the discussion of tube mechanics (Part 1, Fig. 7), we see here a similar phenomenon of uncoiling. We know that a tube fixed at the extremities of both limbs cannot uncoil without a simultaneous dilatation or distention. We can at once make a diagnosis of the latter if this be the aim. Once we have learned the

Fig. 3*c*. Diagrammatic outline of Figure 3*b*.

appearance of the normal type of uncoiling, the sclerotic uncoiled aorta is quite striking, i.e., elongation and separation of the

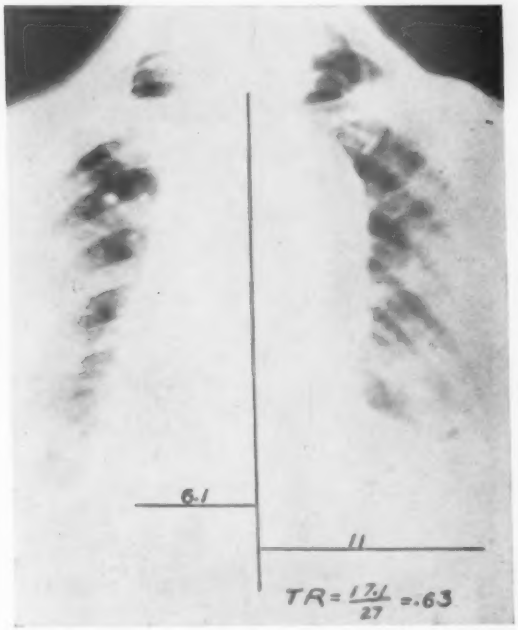

Fig. 4*a*. Syphilitic aortitis. Teleroentgenogram of the chest of a patient, aged sixty; blood pressure, 140/80; Wassermann reaction, 4 plus; aortic regurgitation and failure of the anginal type. Note the tremendous elongation and tortuosity of the aorta. The heart is enlarged and horizontal in position.

arch limbs (the former more than the latter) and tortuosity (lordosis). The measurements simply aid in expressing this phenomenon.

Figures 2*a* and 2*b* are inserted because they so beautifully demonstrate the relation of the aortic arch and the pulmonary artery in the left anterior-oblique position.

The sclerotic aorta seems to be more dense than the normal adult type since it offers greater opportunity for contrast.

But it is well to state here that as a criterion for the determination of a pathologic aorta, it is very hazardous and ephemeral.

SYPHILIS

Let us first renew our knowledge of the syphilitic aorta through the splendid description of Longcope:[4]

Microscopically the earliest lesions which may be definitely recognized show that all three of the main coats of the aorta are involved. The adventitia shows small accumulations of small round cells about the vasa vasorum and the intima of both arteries and veins may be thickened. Minute blood vessels extend into the media, and are surrounded along their courses by accumulations of plasma cells, small round cells and epithelial cells. Slight breaks in the elastic tissue are observed in Weigert's stain. The cells of the intima are proliferated and heaped up to form a projection from the inner surface of the vessel.

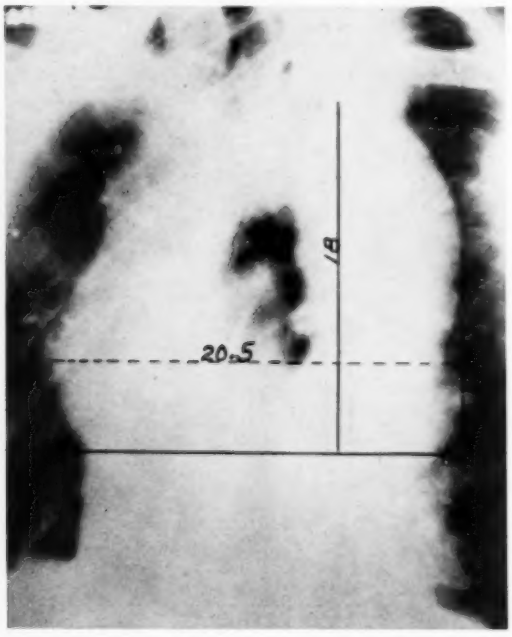

Fig. 4*b* Left anterior-oblique view. Note the tremendous uncoiling. The marked associated elongation and tortuosity suggest the changes that take place when general syphilitic involvement of the aorta is combined with extensive sclerosis.

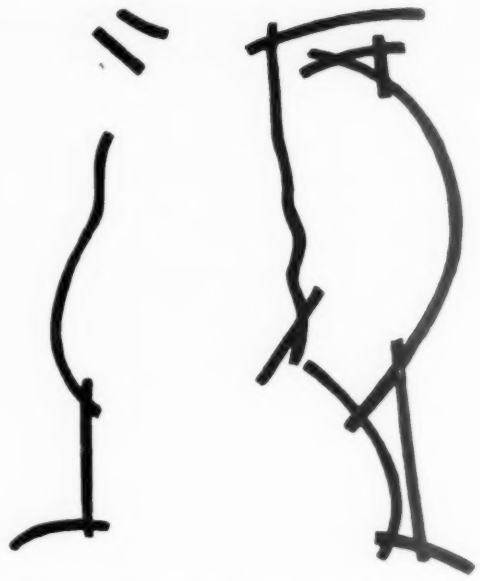

Fig. 4*c*. Diagrammatic outline of Figure 4*b*.

In the more extensive lesion, the perivascular infiltration of the adventitia is very pronounced. The media presents very characteristic areas of coagulation with plasma cells and small round cells. Giant cells may be encountered. They sometimes contain fragments of elastic tissue. The elastic tissue in special stains is seen to be destroyed, torn and fragmented and is usually entirely absent in the center of such a patch. The cellular proliferation of the intima is marked. These areas of necrosis or miliary gummata, may be of considerable size, and in two specimens which I have studied, they involved not only the media but large areas in the adventitia and even the adjacent heart wall, forming true gummata, which were readily visible microscopically. There is frequently a sacculated dilatation of the arterial wall which may vary from a depression scarcely perceptible to a well formed aneurysm of small size.

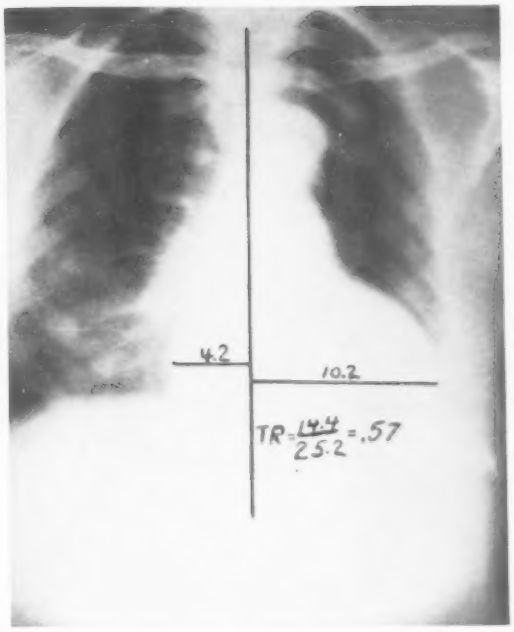

Fig. 5*a*. The aorta in hypertensive heart disease. Teleroentgenogram of the chest of a patient, aged fifty-six; blood pressure, 220/120; Wassermann reaction, negative; rough systolic murmur over precordium and failure of the congestive type. Note the horizontal position of cardiac shadow and exaggeration of the superior portion of the left ventricular arc.

The third characteristic picture appears to represent a later stage of the process, and shows a scarred distorted vessel wall almost unrecognizable as such with perhaps complete destruction of all three coats of the artery. Small foci of necrosis surrounded by connective tissue, partly vascularized and infiltrated with varying numbers of plasma cells and small round cells take the place of media, and extend in marked instances both to adventitia and media, while in appropriate stains the coiled fragments of elastic tissue may be seen here and there throughout the lesion.

In certain cases we have found but one of these three types or stages of the process, but as a rule two or all of them are seen in different portions of the vessel walls.

Extending from the root of the aorta the process frequently involves the valves of the aortic orifice and the aortic ring itself. The changes in the valves in such cases consist in localized and diffuse infiltrations of small round cells and plasma cells.

Figures 3*b* and 3*c* demonstrate the type of uncoiling usually observed in a syphilitic aorta. In this case if one employs as a criterion of dilatation a convexity of the supracardiac shadow at the base beyond the right auricle in the frontal view, there would be difficulty in establishing this diagnosis. The obliteration of the aortic knob noted here by some authors finds its explanation in the aortic uncoiling.

Figures 4*b* and 4*c* represent a case of tremendous uncoiling. The marked associated elongation and tortuosity suggest the changes that take place when general syphilitic involvement of the aorta is combined with extensive sclerosis. In such cases, one would expect to find the convexity (lordosis) described in the preceding paragraphs. Occasionally one observes patients with syphilitic aortitis without uncoiling. Such cases are to be expected in syphilitic aortitis of short duration. It

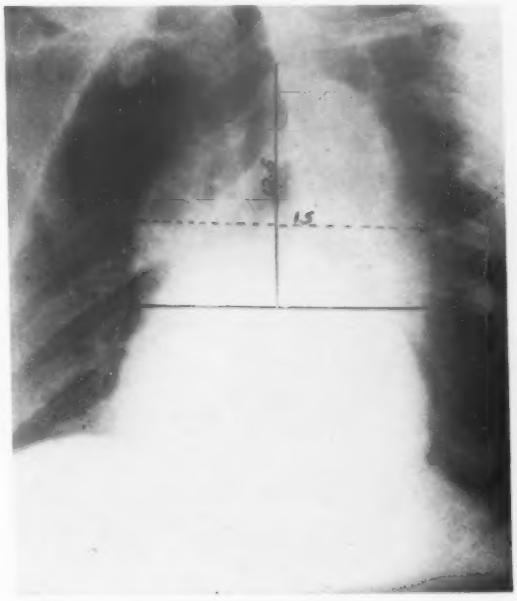

Fig. 5*b*. Left anterior-oblique view. Note the striking appearance of the uncoiled aorta and the superiority of the information derived from this view over that from the frontal, Figure 5*a*. Also note that the appearance of the uncoiled aorta, per se, cannot be used for differential diagnosis between the sclerotic, syphilitic, and hypertensive aorta.

Fig. 5c. Diagrammatic outline of Figure 5b.

would be interesting to observe such patients with this method over a period of years to note the uncoiling.

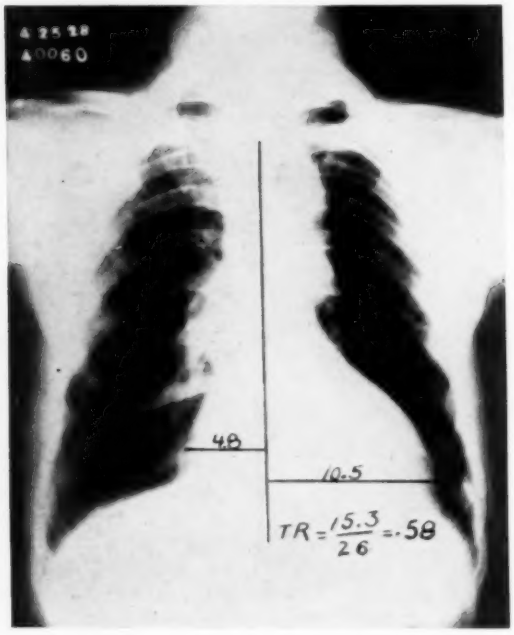

Fig. 6a. The aorta in hypertensive heart disease when combined with arteriosclerosis. Teleroentgenogram of the chest of a patient, aged seventy-two; blood pressure, 180/98; no cardiac failure. The heart is slightly oblique with exaggeration of the superior portion of left ventricular arc.

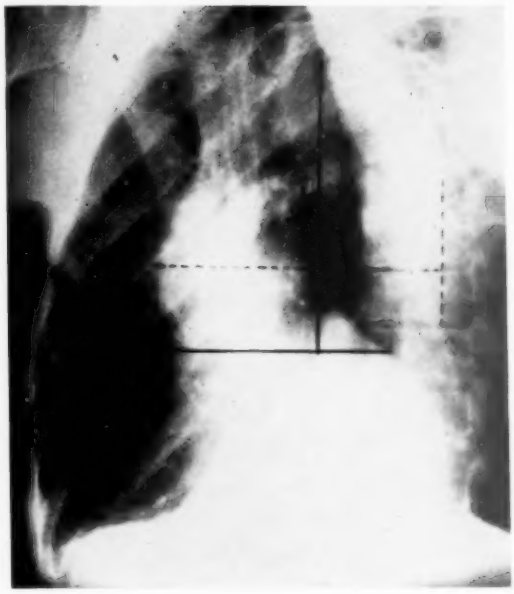

Fig. 6b. Left anterior-oblique view. Note the appearance of uncoiling of the typical sclerotic aorta, i.e., elongation and tortuosity (lordosis); the increase in the longitudinal measurement is more marked than in the transverse.

HYPERTENSIVE HEART DISEASE

Aschoff[2] described the aortic changes in hypertensive heart disease as follows:

Hypertonia, whether primary or secondary to an arteriosclerosis of the kidneys never leads

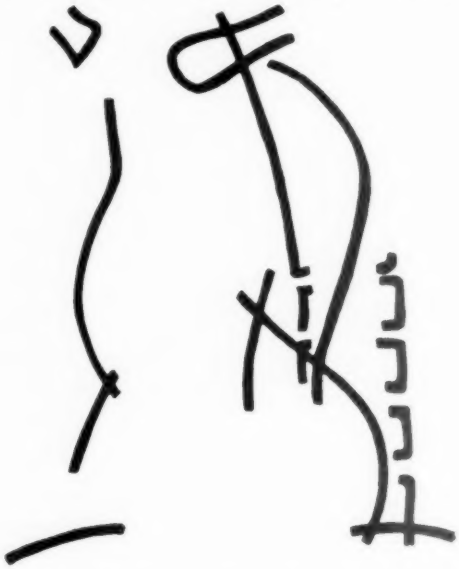

Fig. 6c. Diagrammatic outline of Figure 6b.

to an atheromatosis, but to a true hypertrophy of the entire aortic system with involvement of all the coats, while the real atheromatosis of the aorta is primarily a disease of the intima.

Figure 5*a* presents a typical manifestation of the aortic changes in a patient with hypertensive heart disease. The pathologic uncoiled aorta is at once demonstrated in the left anterior-oblique position. Note the superiority of this view to the frontal in demonstrating alterations in the aortic tube. Figure 6*a* reveals the typical type of sclerotic aorta associated with hypertension. The sclerotic aorta is usually associated with a small cardiac shadow presenting an oblique, flattened left ventricular contour.

In this group it was noted that several patients presented the characteristics of a normal aorta in the presence of tremendously high blood pressure. This is difficult to understand. Usually the aorta is distinctly uncoiled in the presence of high blood pressure. These patients presented symptoms of marked parenchymatous nephritis. The pure type of hypertensive disease is not associated with these kidney changes. Is there some substance elaborated which acting through the circulation directly upon the aorta or indirectly through the nervous innervation, causes a marked opposing contractile force in the aortic muscular and elastic tissue?

RHEUMATIC HEART DISEASE

As far as I am able to learn, there are no typical changes described for rheumatic disease of the aorta which are generally accepted by pathologists.

In patients presenting the typical manifestations of rheumatic heart disease, the absence of pathologic uncoiling of the aorta is quite conspicuous.

In this group one finds not infrequently a patient with involvement of the aortic valves and enlargement of the heart confined to the region of the left ventricle and no pathologic uncoiling of the aorta. A

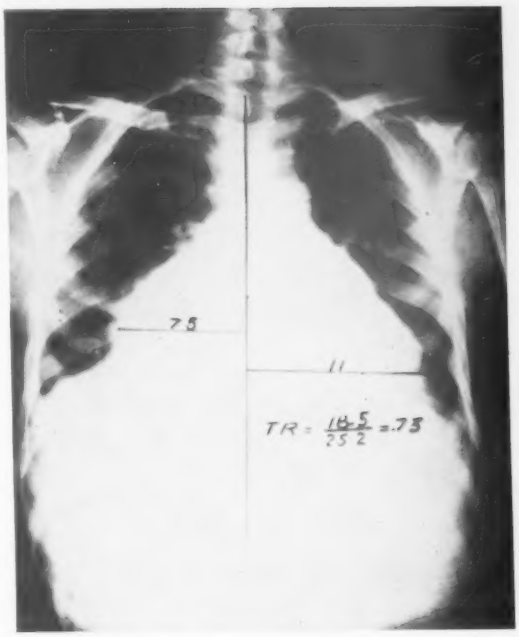

Fig. 7*a*. The aorta in rheumatic heart disease. Teleroentgenogram of the chest of a patient, aged thirty-nine; blood presure, 90/68; Wassermann reaction, negative; mitral stenosis and regurgitation, auricular fibrillation and failure of the congestive type. Note the exaggeration of all cardiac arcs with a marked increase of the transverse ratio.

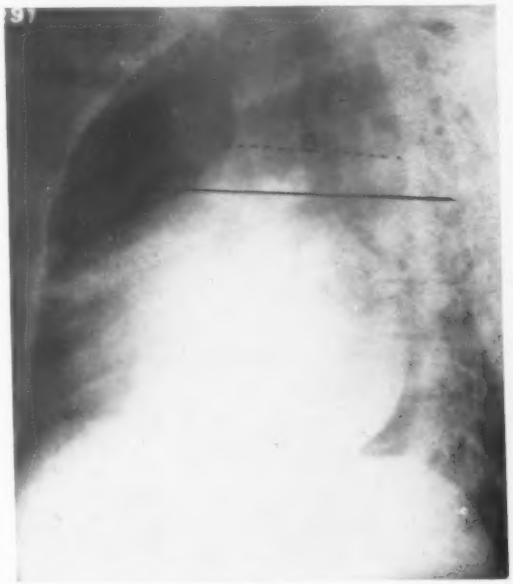

Fig. 7*b*. Left anterior-oblique view. Note the absence of pathologic uncoiling.

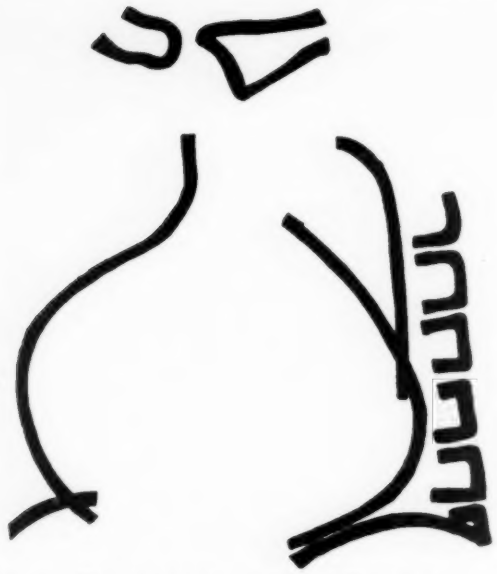

Fig. 7c. Diagrammatic outline of Figure 7b.

comparison of the findings in such a patient with those of the syphilitic group revealing similar cardiac configuration and involvement of the aortic valves, will reveal a distinct pathologic uncoiling of the aorta in the latter. This is confirmatory of the observations made by Holmes,[3] that no dilatation of the aorta is noted in rheumatic disease involving the aortic valves.

On the other hand, one finds in the syphilitic group, patients with enlargement of the heart confined to the region of the left ventricle and no pathologic uncoiling of the aorta. In all probability, these represent hypertrophy of the left ventricle, without aortic regurgitation; in other words, syphilitic interstitial myocarditis as described by Warthin.[6]

CONCLUSIONS

Reviewing these considerations, it will be noted that the aorta may be pathologically uncoiled as a result of senile sclerosis, hypertensive heart disease, and syphilis. It must be clearly understood that the roentgen appearance of the uncoiled aorta, per se, will not differentiate between these three etiologic factors. The cardiac configuration may be of some aid. The determination of a pathologic uncoiled aorta is but the positive demonstration of a volumetric change. As such, I believe it will prove to be a distinctly valuable roentgen contribution to our methods of physical diagnosis and should be of great aid where accuracy is desired. It may be after many serial observations have been made, that it will prove of prognostic import, possibly in the manner of the electrocardiograph in cardiac disease.

In the final analysis, at the risk of stating a platitude, the roentgen observations should always be correlated with those clinically determined.

SUMMARY

1. Four types of heart and aortic disease are discussed, viz., arteriosclerotic, syphilitic, hypertensive, and rheumatic.

2. The character of the uncoiled aorta in these conditions is described and illustrated.

3. The aorta may be pathologically uncoiled as a result of senile sclerosis, hypertensive heart disease, and syphilis, but the roentgen appearance of the aorta, per se, cannot be used for differential diagnosis.

4. The need for combined clinical and roentgen serial study of the aorta is stressed.*

* I wish to make grateful acknowledgment to Dr. George W. Holmes for his kind suggestions and criticism of this paper; to Drs. Laurence Jones and G. C. McCormick for suggestions and aid in the injection of cadavers; to Dr. B. C. Bahr for his translations of the foreign articles; to Dr. Robert Koritschoner for his suggestions concerning the pathologic discussions; to Mr. Robert Stoltz, Miss Elsa Boehm, and Mr. Simon Cohen for aid in the preparation of illustrations.

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THE TREATMENT OF ANGINA PECTORIS BY PARAVERTEBRAL SHORT WAVE RADIATION*

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THE roentgen treatment of angina pectoris at this hospital was suggested by the recent work of Mixter and White[20] who inject the stellate and upper dorsal sympathetic ganglia with alcohol. This work is based on the theory that the pain of angina pectoris is transmitted through rami communicantes to the spinal nerve roots, and that the greater part of these painful sensations are transmitted through the upper dorsal roots. Swetlow[29] believes that the somatic representation of anginal pain on the surface of the body indicates the roots through which these painful sensations pass. Dr. Holmes, therefore, suggested the possibility of influencing these ganglia by roentgen radiation, in the hope of achieving the good results obtained by injection or sympathectomy, without the disadvantage of an operative procedure.

A review of the literature showed that paravertebral irradiation had already been used in the treatment of angina pectoris. The earliest reference is to Groedel,[13] in 1923, details of which are not available. There are two reports in the American literature: Ecker,[10] in 1927, and Torbett,[32] in 1929, each of whom treated one case with marked improvement. The most extensive work is reported from France where a group consisting of Barrieu, Nemours-Auguste and Lian have made several communications.[4,5,17,21] They regard angina pectoris as a crisis of the cardio-aortic plexus, and irradiate the upper segments of the spinal cord when all other physical methods fail to give relief. The technique is one skin unit dose given over a period of three or four weeks to the cervical segments of the spinal cord in a dorsoventral position, and to the upper dorsal segments in the ventrodorsal position, the rays being directed through the left anterior chest wall. In their communication in 1928, they reported having treated 30 cases over a period of one year and state that the usual result has been a considerable decrease in the intensity and frequency of the attacks of angina pectoris beyond that to be expected spontaneously, and that the effect has continued for at least several months. In 1929 they reported 54 cases, all grave and chronic, which had been unsuccessfully treated by other means; 31 were completely relieved of pain; there was amelioration of the pain in 8; there was no effect in 5; 1 was aggravated and 6 died within the duration of observation. The last 7 cases are given in detail. All 6 who died were persons over sixty-six whose deaths may well have been incidental and not related to treatment. A letter from Vienna[5] in September, 1929, reports 7 further cases in which the crisis and all its concomitant symptoms ceased—even the arrhythmia improved.

Arrillaga[3] of South America has also used this method of treatment. He uses short wave therapy, and in the latter part of 1928 reported 8 cases which were successfully treated. One was treated in November, 1926, with complete subsequent relief. The other 7 cases have remained well for eight to twelve months. He believes that the effect of the radiation is on the stellate ganglion, the third cervical sympathetic ganglion and their rami communicantes, with general lessening of nerve excitability.

The advisability of a procedure which removes the anginal pain may be questioned and must be seriously considered since

* Read at the Radiological Conference (New England Roentgen Ray Society, New York Roentgen Society, Philadelphia Roentgen Ray Society, Radiologists of Washington, D.C., Radiologists of Baltimore, Md.), Boston, Mass., Jan. 24–25, 1930.

the warning to the patient of his condition is removed. The same objection is present, of course, with alcohol injection or sympathectomy, and to a greater degree. Roentgen radiation probably has no effect on the patient's cardiac condition. Schweitzer has reported myocardial degeneration following irradiation of the chest, but he used large doses—two erythema doses front and back, and one-half erythema dose to each axilla. Thibaudeau and Mattick[31] report 10 cases which received irradiation over the chest for malignancy. The heart muscle showed fibrosis which seemed rather more diffuse than in the controls, hyaline and fatty changes, and a loss of definiteness in the cross striations. There was an increase in the fluid content of the heart muscle with separation of the muscle fibers by a poorly staining, loosely woven alveolar tissue presenting a somewhat dropsical appearance. Davis[8], however, found no essential change. Emery and Gordon[11], and Warthin and Pohle[33] experimentally found no gross nor microscopic changes in the hearts of their animals. Laubry[16] is the outstanding objector to the method; he says that it has been tried without result for years by many radiologists, but fails to give references. He further claims to have seen 3 cases that Nemours-Auguste had treated that were made worse. Chaperon[6], too, has emphasized the fact that there are dangers associated with the method.

That angina pectoris can be relieved, in certain cases, by irradiation seems apparent from the literature, and from the work at this hospital, but an explanation of the mechanism presents many difficulties. Angina pectoris is a clinical syndrome with fairly marked features but without any definite single causal pathologic state, as McCrae[19] has pointed out recently. It should be clearly distinguished from acute coronary artery occlusion which has a definite pathologic basis. It is not always due to coronary artery disease, nor to a "tired heart muscle." There are probably several factors which may be operative in causing an attack, in the aorta, coronaries, myocardium or nervous system.

It seems desirable to attempt to answer Dr. Holmes' original suggestion: "Can the sympathetic ganglia in the upper dorsal region be influenced by roentgen radiation?" Desjardins,[9] in 1927, made the following observations:

> The analgesic property of roentgen rays is a matter of daily observation in the radiotherapy of benign and malignant tumors. In fact, abolition or diminution of pain is often the first sign of the effect of the rays noted by the patient and this may occur quite early, before any change in the size of the tumor can be perceived. Perhaps the mechanism of the analgesia is relief of pressure on the sensory nerves by destruction of the tumor cells in tumors, or lymphocytes in inflammations. However, the relief of perianal pruritus, neuralgia, the spasmodic manifestations associated with certain traumatic injuries of nerves lead one to the conclusion that there must be a true specific action on nerve cells. There is evidence that nerve cells, which of all the cells of the body are the most resistant to radiation so far as functional or organic damage is concerned, are acted on in a specific manner and their irritability diminished by radiation.

Histopathological findings on the sympathetic after roentgen or radium treatment, are seldom recorded. Terplan[30] found in sympathetic ganglia of malignant tumors small changes in some nerve tissue, namely, chromatolysis, vacuolization, loss of nuclei, plasma cells with large granules or too small nuclei. Increase in the histiocytes of the brains of irradiated mice has been noted. There seems to be a definite effect upon the nerves supplying blood vessels. The work of Richter[27] indicates that dilatory fibers are stimulated by weak radiation while with stronger radiation there is vasoconstriction. With unusually strong radiation, there is permanent dilatation.

Horsley and Finzi[14] in studying the effect of radium on adult mammalian brain, employed as a strictly clinical procedure, state that there is no influence discoverable

by present methods on nerve tissues, but notable changes are found in the blood vessels. Danysz,[7] London[18], Obersteiner[22], Alquier and Faure-Beulieu[2] found various degrees of hemorrhage and round cell infiltration around the blood vessels but the nerve cells appeared unaltered. Pendergrass, Hayman, Houser and Rambo[23] in studying the effect of radium on normal brain tissue showed the same pathological processes. In addition, they call attention to an increase in the weight of the treated hemispheres, the increase seeming to bear more relation to the time the dog lived after the operation than to the dose of radium given. The increase in weight was explained as being due to edema.

There are very few recorded impressions on the effect of radiation on sympathetic ganglia. Warthin and Pohle[31] found marked vacuolization of the ganglion cells, and a very marked edema of the ganglia, following irradiation of the mediastinum. There was a very marked change in the mediastinal structures and a necrosis of the bronchial epithelium. Our experiments partially confirm this latter impression. Two cats from which Dr. James White removed the left stellate ganglion as controls, received roentgen radiation over the posterior dorsal region. One received 620 ma-min. (1600 R) short wave therapy; the other, 960 ma-min. (3200 R) medium wave therapy. Three weeks after irradiation the right stellate ganglion was removed, the cats surviving both operations. The irradiated ganglia appeared definitely grossly edematous and "woolly," to the surgeon, pathologist and myself. Examination of the microscopic sections, however, failed to reveal any changes in the irradiated ganglia that were not also present in the controls. I am indebted to Dr. Kubick for these examinations. At operation, the surrounding tissues did not appear to be edematous, but this latter observation will be confirmed by future experiments. Examination of autopsy material in humans that have received mediastinal irradiation, while not yet sufficiently extensive, has presented no new material.

Experiments on the effect of irradiation upon the physiological properties of nerves are also rather sparse. Redfield, Redfield and Forbes,[26] reporting on the action of beta rays, use very much larger doses than are clinically possible. Some statements, however, are perhaps important, to our subject. They say, "Intense radiation with beta rays destroys the functional capacity of a nerve trunk. There may be a marked latent period between the termination of the radiation and the loss of function, the latent period increasing in length as the quantity of radiation decreases." This phenomenon, they say, suggests two distinct processes: the first, some change produced directly by the radiation, which may not itself cause any impairment in the function of the nerve fiber, but as a result of it a second process is set up which goes on even in the absence of irradiation and results ultimately in the destruction of the functional power of the nerve. Microscopic examination of the irradiated nerve reveals fatty degeneration of the myelin sheath.

Langer[15] irradiated the carefully isolated sympathetic in the neck of a cat with unfiltered or lightly filtered rays, and found in the beginning of treatment a wide dilatation of the pupil. Later on, the treated part of the nerve became blocked, judged by reponse to faradic stimulation. Swan,[28] in a similar experiment, determined the minimum faradic current which would just cause enlargement of the palpebral fissure. After short exposures to roentgen rays he found that weaker currents produced the same effect as before but that after prolonged exposure, a stronger current was required. He concluded that the autonomic nervous system is rendered supersensitive by moderate exposure to roentgen rays and less sensitive by larger doses.

Certainly we can say from our experiments and observations in treated cases that irradiation of the sympathetic trunk

in situ, does not cause miosis as happens with sympathectomy, nor does it have any appreciable effect on the pulse rate. These observations are being continued, each case being followed by electrocardiograms, and sensory status examinations, where possible. Results on the motor function of the sympathetic cannot be directly transferred to the problem of pain, however, although there must be great similarity. Ransom,[25] for example, states that pain travels along non-myelinated fibers, while it is Adrian's opinion[1] that the fibers from the various receptors may differ somewhat in their time relations, but the fundamental activity, the nerve impulse, is common to all, and to the motor fiber.

The effects of irradiating the cervical sympathetic may be in the nature of a secondary general effect. Polak[24] states that after extirpation of the uppermost cervical sympathetic ganglia in rabbits, following roentgen irradiation, a miosis appeared which atropine could not abolish, a result which he ascribes to an indirect effect upon the adrenal gland.

Our own results in the radiation treatment of angina pectoris must be regarded in the nature of a preliminary report. To date we have treated 16 cases of severe angina pectoris, none of which had responded to medical treatment and most of which had been recommended for alcohol injection of the dorsal ganglia. With these exceptions, they were unselected. Some had already had alcohol injections with no, or only partial relief. The series was begun five months ago. Of the 16 cases, 4 have not yet returned for observation, one has died. Five have noted moderate improvement in their symptoms, in that either the attacks appear less frequently or are not so severe, due allowance being made for any change in activity. Six have been almost completely relieved, and have at most a slight soreness on undue exertion.

Practically all of the cases have been treated with short wave therapy, the factors being: 200 kv., 0.5 mm. copper and 4 mm. celluloid filters; 50 cm. target skin distance—effective wave length, 0.166Å.; 4 ma.; field 10×20 cm., arranged so that the 20 cm. length extends along the posterior surface of the dorsal vertebrae from the seventh cervical vertebra, caudally. The vertebral spines are in the midline of the field. In one or two cases, where the anginal pain has been unusually low, a second field covering the lower dorsal vertebrae has been used. The dose has varied between 400 and 500 ma-min. (800 R) given in three divided doses at one to two day intervals. In 4 cases this was repeated one month after the first series. We have always been careful to stay within a slight erythema, preferably giving a suberythema dose.

The following is a typical case in which considerable relief was afforded:

W. L., male, aged fifty-two, with arteriosclerotic heart disease. During the past ten months he has had attacks of pain becoming more severe so that in November while lying in bed, on the ward, he was having from four to six severe attacks of precordial pain radiating down the left arm, every day, occasionally relieved by nitroglycerin. He received 400 ma-min. on Nov. 14, 1929. There was a slight exacerbation of the severe attacks for forty-eight hours following treatment. On Nov. 27, he returned for observation feeling considerably relieved. He wished to return to work. On Jan. 8, 1930, two months after treatment, he returned to the hospital and reported that he had had two severe attacks since being treated, both following exposure to unusual cold. On Jan. 27, he was again admitted to the hospital, complaining of increasing precordial distress of one week duration, at this time having about five attacks of pain a day while lying in bed. He was again treated, receiving 360 ma-min. One day later he was without pain, and has remained so.

E. M., male, aged fifty-seven, had a seven year history of anginal pain subsequent to luetic aortitis. He had an alcohol injection of the upper five left dorsal ganglia in December, 1926, with complete relief from the left-sided pain. Severe right-sided pain, however, persisted for

which an attempt to inject the right dorsal ganglia on three different occasions failed to yield relief. In November, therefore, he was having three or four right-sided anginal attacks a day, when resting; six to ten on exertion. He received 400 ma-min. over the upper dorsal vertebrae, in the latter part of November, 1929. He returned in the middle of December reporting that the attacks were less frequent but just as severe. The pain was now largely in the hypochondrium. It was therefore thought desirable to irradiate the lower dorsal ganglia. He received 360 ma-min. over this region. He reported on March 4, 1930, stating that he had had no severe attacks since this last treatment, and except for a soreness about the right nipple, he was completely relieved.

One patient died during the course of observation—a man, aged sixty-two with coronary artery disease who had been complaining of epigastric distress for four months, interpreted as anginal in character. For two weeks, the pain had been unusually severe, attacks occurring three or four times a day. He received 360 ma-min. over the upper dorsal vertebrae. Six days after completion of treatment he developed what clinically appeared to be a typical attack of coronary thrombosis and died two days later. Permission for autopsy could not be obtained. It does not seem at all reasonable to ascribe this death to treatment.

These treated cases are entirely too recent to warrant any definite conclusions and they are too few in number. Only extended observation on a large series of cases will provide satisfactory conclusions as to the value of roentgen radiation in the treatment of angina pectoris. Certainly our results warrant the continuation of the method. With the active cooperation of the various departments, particularly the Cardiac Clinic, we hope to accumulate sufficient accurate data to gauge its value.

SUMMARY

The literature on the treatment of angina pectoris by roentgen radiation is reviewed.

A possible mechanism for the relief of pain is considered.

The literature on the effect of roentgen radiation on the nervous system, particularly as it relates to its analgesic action, is reviewed.

Experiments on the effect of roentgen radiation on the sympathetic nervous system are reported.

A preliminary report is made on the treatment in this clinic of 16 cases of angina pectoris by paravertebral irradiation. Six were almost completely relieved; 5 moderately improved; one has died; 4 have not yet returned for observation.

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THERAPEUTIC LEAD POISONING*

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IT IS hoped that this paper will prove of practical importance to those who are using or expect to make use of colloidal lead in the treatment of malignancy. The attempt is made to give the important points in the management of cases of hopeless malignancy in which one expects to produce lead poisoning.

Following this will be reviewed a series of 64 patients who were treated with colloidal lead. In order that the views herein expressed may not seem too heretical, your attention is called to certain recent publications relating to lead therapy by Waters, Colston, and Gay,[8] Ullmann,[7] Soiland, Costolow and Meland,[6] and Knox,[3] These writers (with the exception of Ullmann) have neglected to mention or apparently to take into account, the all-important feature of lead therapy, namely, the mobilization of the lead introduced, either by accident or design, to produce an acute lead poisoning.

There is one thing which stands out more than all others in the use of lead for hopeless malignancies. In order to produce a retrogression of the growth, *it is necessary to produce an acute lead poisoning of the host.* By acute lead poisoning is meant a degree of mobilization of the injected lead which will cause the patient to be deathly sick. The chief symptoms are:

1. Gastrointestinal pain, with colic, inability to retain food or fluids, and diarrhea, with extreme prostration.

2. Muscular pains, chiefly affecting the muscles of the back and thighs and less frequently the arms and forearms.

3. Neurological changes which depend somewhat upon the temperament of the individual and which vary from wrist drop to maniacal insanity.

4. Blood changes which at first are not profound but which, on proper mobilization, will usually result in a drop in the hemoglobin estimation and red cell count of 30 to 50 per cent, with typical changes in the red blood cells consisting not only of the classical stippling, but also a much earlier change which gives the affected red cells a bluish cast.

5. The change in the kidneys in the cases of acute lead poisoning is not so prolonged as most writers would have us believe. Acute nephritis accompanied by transient hematuria with large amounts of albumin, and a tendency towards suppression of urine secretion is not at all rare, yet in my series of cases, it has not been troublesome. It is not frequently found that the patient's phenolsulphonphthalein excretion increases noticeably in percentage after the acute lead poisoning.

The chief problem in the use of colloidal lead is to find some reliable method for the production of acute lead poisoning in these cases which will surely and rapidly mobilize the lead stored in the body or which will prepare the patient to receive colloidal lead so that it will not be stored in the alkali reserve. I believe that the results of this treatment could be greatly improved if some safe and rapid method for mobilization could be found. Such a method should be easily controlled by the administration of alkalies or other substances which would demobilize the lead when necessary.

I shall mention briefly the methods I have used to attain this mobilization and lead poisoning. Acute respiratory infections coincidental to lead administration rapidly and effectively mobilize the stored lead. The patients who became very sick with all the symptoms of acute lead poisoning, ultimately recovered or showed at autopsy a complete regression of the malignant lesions. From this it seemed important to attempt to produce artifici-

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ally an acidosis or other condition which would mobilize the stored lead within the body. We found that those cases in which the growths showed the most complete regression were those who had been the sickest, and in looking over our series of cases,

(1) We found that patients receiving large amounts of roentgen rays through the upper abdomen developed a severe acidosis which was probably due to starvation and dehydration, and that the lead was mobilized when they were in this state.

Sarcoma Group

Case No.	Location Primary Growth	Cell Type	Previous Treatment	Lead mg.	Date	Mobilization	Other Treatment	Died	Living	Remarks
1	Groin	Round Cell	Excised twice	556	11–'26	+++	None		6–1–29	
15	Neck	Myxo-sarcoma	Excision	360	1–'27	—o—	None	3–3–27		
18	Thigh	Mixed	Excision, x-ray and radium	300	2–'27	+	None	5–2–27		Mental disease
23	Tonsil	Lympho	Tonsilectomy, section	240	3–'27	+++	X-Ray		10–1–28	Not traced
27	Small intestine	Lympho	Excision	316	5–'27	+	X-Ray	11–27–28		
47	Femur	Round	Curettement	316	4–'28	++++	None	6–9–28		General sepsis
53	Groin	Round	Excision, x-ray and radium	300+	7–'28	++++	None		6–20–28	
54	Naso-pharynx	Lympho	None	530	7–'28 12–'28	Intentional +++	X-Ray and radium	1–7–29		
55	Forearm (Bone)	Mixed Fibro-sarcoma	Antiluetic treatment, fulguration, Radium, and amputation	316	7–'28	+	X-Ray and radium		6–27–29	Metastatic skin nodules
64	Thigh	Round	Excised Twice	428	1–'29	Intentional +++	X-Ray	6–4–29		Sepsis and amputation

Table 1. Ten sarcomas were treated as shown in this chart. It will be noted that only those cases in which severe mobilization took place, notably Cases 1, 23, and 53, are living and well at this time. Cases 47 and 64 died of general sepsis and Case 55, which is still alive and did not have a good mobilization, now has metastatic skin nodules. Three of the 10 cases are living and well, a fourth is living but has skin metastases; a total of 4 living an average of more than seventeen months.

it will be noted from the charts that the only patients who have received good palliative results with complete regression of their growths, are those that are indicated on the charts as having a *three* or *four plus* mobilization. These patients were deathly sick. In the latter part of the series we have attempted to produce mobilization of the lead by several methods:

(2) The intravenous injection of horse serum and typhoid bacilli produced increased temperatures (sometimes genuine anaphylaxis), with a slight degree of mobilization.

(3) Aub, Fairhall, Minot, and Reznikoff[1] in their book on "Lead Poisoning," call attention to the fact that lead may be mobilized by the use of ammonium chlor-

ide in large doses, the inference being that 1 gm. per day would have some definite effect. Koehler[4] also called attention to this fact. I have given 2 patients whose weights were respectively 112 and 125 pounds, from 10 to 12 gm. of ammonium chloride per day for periods of from eighteen to twenty-one days before mobiliza-

Cancer of the Ovary

Case No.	Cell Type	Previous Treatment	Lead mg.	Date	Mobilization	Other Treatment	Died	Living	Remarks
17	Intercystic papillary	Excision, hysterectomy	460	2–'27	Influenza ++++	X-ray, 1750 ma-min.	5–30–27		Lead poisoning
19	Adenocarcinoma	Excision	300+	2–'27	?				Not traced
37	Medullary	Excision	428	8–'27	?	X-Ray	5–12–28		
38 59	Intercystic papillary	Excision	642	10–'27 10–'28	Intentional +++	X-Ray X-Ray		6–27–29	Had more than twelve liver nodules
39	Adenocarcinoma, solid	Excision	300+	11–'27	Intestinal obstruction +++	X-Ray	2–24–28		Intestinal obstruction
40	Intercystic papillary	Excision	350	12–'27	Influenza ++++	X-Ray		6–27–29	Questionable recurrence
42	Adenocarcinoma, solid	Excision	308	2–'28	+	X-Ray	7–5–28		Intestinal obstruction
44	?	X-Ray	200+	4–'28	+++	None	4–20–28		Intestinal obstruction
52	Intercystic papillary	Hysterectomy, excision	318	7–'28	By x-ray +++	X-Ray		6–27–28	Doing well
56	Adenocarcinoma, solid	Excision, x-ray	300+	8–'28	By x-ray ++++	X-Ray	10–7–28		Cardiorenal disease

Table II. Ten carcinomas of the ovary were treated. Case 17 at operation showed innumerable tiny peritoneal implantation metastases, died of lead poisoning and the autopsy showed no evidence whatever of malignancy. The mobilization in this case took place three months after the lead was given and was brought about by an influenzal pneumonia. Case 38 (59) had two series of lead injections, a total of 642 mg. The surgeon who operated on this case counted more than twelve liver nodules up to an inch in diameter. This patient is living and well at this time. She had an intentional mobilization which was brought about by the use of large doses of ammonium chloride and sodium acid phosphate together with a ketogenic diet. The mobilization, however, was not so severe as was desired but a good result has been obtained. Case 40 had an extremely severe mobilization brought about by an attack of influenza and has some questionable recurrence at this time. Case 52 had a mobilization which was brought about by the use of large doses of roentgen rays through the pelvis and upper abdomen and is doing very well at this time. Three cases out of 10 are alive and well.

tion of the stored lead was evidenced, each of these patients having received over 500 mg. of lead. When mobilization did take place, it was believed to be due to poisoning by ammonium chloride.

lead. These writers have called attention to the fact that the increased excretion of stored lead in the body may be brought about by the injection of 10 to 20 units of parathormone per day over periods of

Cancer of the Prostate

Case No.	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
8	?	Two operations	500+	1-'27	+	X-Ray	1-15-28		Cause of death unknown
22	?	Excision and radium	280	3-'27	Incidental +++	X-Ray 2800 ma-min.		6-1-29	Doing well
60	?	None	534	11-'28	Intentional +++	X-Ray 3300 ma-min.		6-27-29	Bone destruction

Table IIIA. Three cases were treated. Case 8 showed no mobilization and died in one year. Case 22 had a mobilization incidental to roentgen treatment in large doses and is alive and well. Case 60 had an intentional mobilization brought about by ammonium chloride and ketogenic diet and is doing well clinically but still has some evidence of the former bone destruction of the pelvis.

(4) Restricting food to a ketogenic diet will help produce mobilization.

(5) Parathormone (Lilly) has been mentioned by Hunter and Aub[2] as very an efficient method for mobilizing calcium

from a few days to a month. Parathormone was tried therefore in 2 cases. One, a women weighing 136 pounds who had received 300 plus milligrams of lead, was given 50 units of parathormone (Lilly) per

Cancer of the Stomach

Case No.	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
14	?	Gastro-enterostomy	500+	1-'27	+++	X-Ray	9-3-27		Good palliation
24	?	Gastro-enterostomy	208	3-27'	+	X-Ray	10-3-27		Good palliation
49	?	None	328	4-'28	?	None	8-14-28		

Table IIIB. Three cases treated, all dead. Two showed good palliation.

and increasing the blood calcium. It was inferred that the use of parathormone would therefore liberate the lead stored with the calcium in the bones and decrease the calcium reserve in the body to a marked degree, thereby mobilizing the

day for a period of seven days without a mobilization of the lead and without raising the blood calcium to a lethal point. The second case was a woman who had received 200 plus milligrams of lead and whose weight was 80 pounds. This patient

was given 300 units of parathormone in three days without a mobilization of the lead or producing hypercalcemia.

(6) A severe mobilization can be produced, however, by excluding carbohydrates from the diet and feeding acid ash foods and giving up to the tolerance of phosphoric acid and acid phosphates. I have given as much as 10 c.c. per day of 84 per cent (syrupy) phosphoric acid diluted in large volumes of water sweetened with saccharin. This in 2 cases produced a mobilization which was almost uncontrollable and which broke down the sarcoma which was metastatic to the liver so that the patient died.

Cancer of the Buccal Mucous Membrane

Case No.	Location primary growth	Squamous cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
2	Floor of mouth	3	Cautery, x-ray and radium	580	12–'26	++	None	11–28–27		Sloughing and deep abscess of neck
29	Cheek	?	Resection	330	5–'27	?	X-Ray 900 ma-min. Radium	10–30–27		
31	Palate	2	Resection, radium	452	6–'27	+	X-Ray and radium		6–28–29	Intracranial metastasis
32	Lip	2	Resection, radium and x-ray	236	6–'27	+	None	8–24–27		Wassermann 4 plus
33	Tongue (base)	?	None	340	6–'27	+	X-Ray and radium			Not traced
34	Lip	?	"Paste"	304	7–'27	+++	X-Ray and radium	9–8–27		Sepsis
57	Cheeks, bilateral	?	None	336	8–'28	Incidental ++++	Radium and x-ray	3–17–29		Cellulitis, face and neck
58	Cheek	2	Biopsy	300+	8–'28	Incidental ++++	Radium and x-ray	5–26–29		Cerebral hemorrhage and sepsis
67	Antrum	?	Biopsy	110	1–'29	+	X-Ray	2–10–29		Sepsis

Table IV. Nine cases were treated. Only one case is alive, but has evidence of intracranial metastasis. Five of the 9 died either directly or indirectly from infection and I am led to the conclusion that I am overtreating buccal cancers, probably by using too much radium and producing too much necrosis, with its consequent infection. At any rate, the treatment of buccal cancer by this method has been extremely discouraging and the only light that is seen is from the fact that Cases 2, 34, 57, and 58, showed no evidence of malignancy at the time of death.

I have not been able to find a satisfactory method for producing lead mobilization. It is possible that a high degree of alkalinization (Koehler, Hunter and Aub) may produce the desired mobilization, but I have not been able to carry out alkaliniza-

tion to a point where the lead will be mobilized.

There are no definite criteria for estimating the degree of mobilization that is taking place, but it is of help to make daily determinations of the pH of the urine and CO_2 combining power estimations on blood.

We have found that mobilization of lead (in the case that has received at least 2 to 4 mg. per pound of body weight) will take place when the CO_2 combining power falls below 45 to 48 volumes per cent and the pH of the urine remains at 5.0 to 5.4 as determined by Sansum's method.

We have made some determinations of the blood pH by means of a specially constructed Leeds and Northrup potentiometer, but we have found that it is an extremely delicate method for the average laboratory to carry out and we have not been able to draw any definite conclusions

Cancer of the Breast

Case No.	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
6	Scirrhous	Radical, x-ray	532	12–'26	Influenza +++ Pneumonia	X-Ray	3–31–27		No malignancy at time of death.
9	?	Amputation	220	1–'27	+	None	10–9–27		
16	?	Amputation	200+	1–'27	+	X-Ray	4–4–28		Did not die of cancer of breast.
20	?	X-Ray, section	400	2–'27	++	X-Ray, radium	12–12–28		Good palliation
30	Solid	None	434	6–'27	+	X-Ray, amputation	8–15–27		"Heart attack."
35	Scirrhous	Radical, x-ray	300+	8–'27	+	X-Ray		6–1–29	Local and distant metastases.
46	Solid	"Science"	416	4–'28	Intentional ++++	X-Ray	7–8–28		Pneumococcic meningitis
61	Paget's	Radical	330	11–'28	Incidental to labor pneumonia ++++	Radium, x-ray, antiluetic	2–8–29		Wassermann 4 plus

Table v. Eight cases were treated with only one case living and this patient shows both local and distant metastases. This presents a very hopeless situation but good palliation was obtained in several of the cases, notably Cases 6, 16, 20, and 30. Case 46 presented many interesting features. This patient had metastases to the spine, head of the femur, and liver, and died of a pneumococcic meningitis three months after the colloidal lead treatment. At autopsy no evidence of malignancy could be found anywhere. The liver showed depressed scars at the sites of the previous metastases. Examination of the spine which had previously shown malignant involvement showed no roentgen or clinical evidence of malignancy. The case of Paget's disease (Case 61) showed very little change in the rate of growth from the very severe mobilization which was incidental to a lobar pneumonia.

as to the degree of mobilization as expressed in pH changes in the blood. I believe, however, that with a refined technique in the hands of a capable technician, direct readings on cooled whole blood can be made before clotting takes place.

I think, however, the problem is more complicated than would seem apparent and that the lead stored in the body is linked very intimately with the alkali reserve of the body and that mobilization does not take place until the alkali reserve falls to a pathological level.

When mobilization has been accomplished and the patient is reaching a point where you believe that he will probably succumb in the next forty-eight hours, then is the time to demobilize the lead, and combat the acidosis.

Whatever is done, must be done quickly and effectively. Calcium salts have been recommended for this and I have given several patients who were in a state of acute lead poisoning as much as 4 gm. of calcium chloride intravenously per day for three days without noticing the least change for the better in the patient's condition. However, the intravenous administration of 5 or 6 gm. of anhydrous sodium carbonate will frequently change the patient who is unconscious, definitely moribund, into a comparatively well individual within ten minutes. It is also advisable to give alkalies and glucose per rectum. I have used as high as 1500 c.c. of 5 per cent sodium bicarbonate and 5 per cent glucose every twelve hours until alkalies could be taken by mouth, which is two to

Cancer of the Cervix and Uterus

Case No.	Location Primary Growth	Cell Type	Previous Treatment	Lead mg.	Date	Mobilization	Other Treatment	Died	Living	Remarks
3	Uterus	Solid Adeno-carcinoma	Excision	496	12–'26	+	None	5–19–27		Masses softened
11	Cervix	Squamous 2	Excision, x-ray and radium	540+	1–'27	++++	None	4–4–27		Lead poisoning, intestinal obstruction?
26	Cervix	Squamous 2	Excision	200	4–'27	Treatment discontinued				Not traced
36	Cervix	Squamous 2	Radium and hysterectomy	300+	9–'27	+	X-Ray 2400 ma.min.	4–1–28		Mass sloughed out
41	Cervix	Squamous 1	Colloidal lead, fulguration	80	1–'28	Treatment discontinued		5–4–28		Weakened from hemorrhage and lead
51	Cervix	Squamous 3	Hysterectomy	108	5–'28	+	X-Ray and radium		6–1–29	Recurrence but good palliation
63	Cervix	Squamous 3	X-Ray and radium	206	12–'28	Intentional ++	None	1–30–29		Hydro- and pyonephrosis
66	Cervix	Squamous 2	Cautery	110	1–'29	Treatment discontinued		3–29–29		

Table VI. Of the eight cases treated, 7 were primary in the cervix. None of these cases showed a complete retrogression. The only survivor, Case 51, has developed a mass in the rectovaginal septum which is probably malignant.

three days. It is advisable to give sodium bicarbonate by mouth even though the patient is vomiting, and to give small amounts of magnesium sulphate by mouth so that the lead that is excreted into the gastrointestinal tract will be fixed in a relatively insoluble form.

special care was taken to prove the diagnosis by section or by indisputable clinical evidence. Sections were taken from every case except those in which biopsy would have been extremely hazardous. We found that very surprising mistakes occurred in 3 of these cases.

Cancer of the Rectum and Colon

Case No.	Location Primary Growth	Cell Type	Previous Treatment	Lead mg.	Date	Mobilization	Other Treatment	Died	Living	Remarks
7	Recto-sigmoid at juncture	Colloid	X-Ray, radium, colostomy	560	1–'27	+	X-Ray and radium	9–19–28		Moribund
10	Rectal, ampulla	?	X-Ray	300+	1–'27	+	None	4–17–27		
12	Anus and rectum	Cuboid	X-Ray, radium, colostomy	560+	2–'27	++	None	3–25–27		Moribund
13	Descending colon	Cylindrical	X-Ray, radium, colostomy	452	2–'27	++	None	4–25–27		Moribund
21	Rectal, ampulla	Cylindrical	X-Ray, radium, colostomy	340	3–'27	++++	X-Ray 1500 ma.-min.		6–15–29	
28	Recto-sigmoidal juncture	Cylindrical	X-Ray, radium, colostomy	318	5–'27	++++	X-Ray 2000 ma.-min.		5–25–29	
43	Rectal, ampulla	Spherical	"Science"	308	2–'28	+++	X-Ray 3000; radium 3000		6–1–29	
45	Rectal, ampulla	?	None	200	4–'28	Treatment discontinued—not traced				
50	Anus and rectum	Spherical	X-Ray, radium and Glover's serum	304	5–'28	++++	X-Ray, radium, colostomy	12–13–28		Gas gangrene
68	Rectum	?	None	300+	2–'29	++	X-Ray, radium, colostomy	5–5–29		Cerebral hemorrhage

Table vii. Ten cases were treated with 3 cases alive and well an average of more than twenty-two months after treatment. Two of these cases, notably 21 and 28, had received large amounts of roentgen rays and radium, and had gone from bad to worse with very little palliation obtained. Case 21 had a very severe mobilization which lasted for about three weeks and Case 28 had equally severe mobilization for about two weeks. Case 43 mobilized incidentally to a drinking debauch. All of them remain alive and well.

These then are the salient features of the therapeutic uses of lead. I would advise against using this agent unless it can be given in large doses which, when mobilized, will give a lethal poisoning.

I wish to report briefly a series of 64 cases of hopeless malignancy in which

One was a case sent in as abdominal malignancy of unknown origin, metastatic to the liver. We insisted upon laparotomy to obtain a section for accurate diagnosis before attempting lead treatment and found that the liver had several small and large nodules up to the size of an egg.

Sections from two of these nodules showed gumma and the patient is alive and well on antiluetic treatment, now more than two years, and has gained 69 pounds. It would have been a great mistake to treat this case without insisting upon a biopsy. This patient had had a laparotomy two weeks before coming to us but the surgeon had neglected to take a section and had closed the abdomen with the idea that the condition was a hopeless malignancy.

In 2 cases, reputable pathologists have misdiagnosed the sections. A review of all sections of these cases has just been accomplished and the diagnoses have been corrected. One, a lymphosarcoma of the small intestine, was called a carcinoma. In another case a lymphosarcoma of the nasopharynx was called an "epithelioma." There are several cases presented here that were not definitely diagnosed by section, notably carcinomas of the prostate which had metastasized to bones of the pelvis and distantly, and carcinomas of the breast, stomach, and ovary which had very definite metastases on which the original section had been lost or misplaced or upon which no examination had been made but which were definitely malignant upon the clinical evidence.

Miscellaneous Malignancy

Case No.	Location Primary growth	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
5	Epithelioma of toe	Squamous 1	Amputation	444	12–'26	++	X-Ray and radium	5–27–27		Chronic nephritis and ascites
48	Xeroderma pigmentosum, cystic	Squamous variable	Cautery, paste, escharotics, fuguration	418	4–'28	+++ +++	X-Ray and radium		6–27–29	Malignant change has been retarded
65	Penis	Squamous 3	Incision	214	1–'29	+	X-Ray	2–27–29		

Table VIIIA. A case of xeroderma pigmentosum that had been very badly scarred and who had hundreds of small malignancies of the face with enlarged cervical glands, which were definitely malignant, mobilized twice, each time due to food poisoning which was thought to be the result of a sensitization to fish. All of the malignancies existent at that time disappeared and the malignant disease has been very much retarded.

Nonmalignant Conditions

Case No.	Location primary growth	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
4	Syphilis of liver	Gumma	None	100	12–'26	+	Antiluetic		6–1–29	Gained 69 lbs.
25	Hodgkin's disease		X-Ray	200	4–'27	+	X-Ray and radium	9–6–28		

Table VIIIB. Case 4 came in diagnosed as abdominal malignancy of unknown origin, metastatic to the liver but was proved by section from liver nodules to be tertiary syphilis. One case of Hodgkin's disease has been treated but with an inadequate amount of lead and without mobilization.

SUMMARY

Group	Number Cases Treated	Number Dead	Number Living	Average Months After Treatment	Remarks
Sarcoma	10	6	4	17.2	
Ovary	10	6	3	17.3	One not traced
Prostate	3	1	2	17	
Gastric	3	3			
Buccal	9	7	1	24	One not traced
Breast	8	7	1	21	
Cervix-Uterus	8	6	1	13	One not traced
Rectum-Colon	10	6	3	22.3	One not traced
Miscellaneous	3	2	1	15	
	64	44	16	18.4	4 not traced

TABLE IX. A summary of the 64 cases of malignancy shows that 4 have not been traced, that 44 are dead and that 16 patients, or 25 per cent are alive an average of 18.4 months after treatment.

SUMMARY

Attention has been called to the following important practical points in the use of colloidal lead:

1. That mobilization of injected lead is essential to obtain favorable results.

2. That the best criteria for estimating the degree of mobilization are determinations of the CO_2 combining power of the blood and the pH of the urine.

3. That there is no satisfactory method of producing mobilization of ingested lead.

4. That the use of large amounts of alkalies by mouth, per rectum, and intravenously, are indicated when rapid demobilization is desired.

5. That a review of 64 cases of hopeless malignancy treated by colloidal lead shows that 16 cases are living an average of 18.4 months after treatment.*

* I wish to express my sincere thanks to Dr. W. W. Haggart, Director of the Cancer Clinic of the University of Colorado, and to Dr. John R. Ranson, formerly my associate, for technical help and valuable advice in the treatment of this series of cases.

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DISCUSSION

Dr. Emil G. Beck, Chicago: I have had no personal experience at all with lead therapy. I wish, however, to comment on the good logic of producing mild lead poisoning in order to destroy the cancer. The results of lead treatment, as shown by Dr. Withers, were good, considering that they represent a group of hopeless cases. I have always contended that if a case is not cured at the first operation it invariably becomes a hopeless case. Dr. Withers has shown us that of this hopeless group, he kept 25 per cent alive for eighteen months. Thus we may hope to develop a method in which a light lead poisoning so gauged as to arrest the disease may prolong the life of a hopeless case.

Prof. Robert T. Legge, Berkeley, Calif.: I

am very much interested in Dr. Withers' research work in regard to the mobilization and storage of lead in the bones when using his colloidal lead treatment for malignancy. I am surprised that he has been unable in his experimental work to obtain the positive calcium balance which favors lead storage as claimed by Aub, Minot and their colleagues at Harvard. I understand from Dr. Withers' paper that he has been attempting to immobilize his patients during lead intoxication by these authors' methods and was unsuccessful.

It seems to me it might be a very interesting undertaking for some of this group to make a study of the great industrial plants, where they have workers who are suffering from lead poisoning. Many of these patients have already the first stages of the lead poisoning, which can be easily diagnosed by the lead gum line and basophilia. It would be interesting to determine whether these lead patients ever suffer from carcinoma or other malignant growths.

Dr. Francis Carter Wood, New York City: I have been long interested in following Dr. Withers' work with colloidal lead. We have no difficulty in New York in producing lead poisoning without mobilizing. Our difficulty has been, rather, to induce the patients to complete the treatment. They suffer so much from nausea and general depression, only a part of which is due to anemia, that it is only the more courageous who will stick it out.

Dr. Henry J. Ullmann, Santa Barabara, Calif.: Dr. Withers spoke of the difficulty of immobilizing lead. One of our patients was acidified with ammonium chloride. Every time this was done she would develop slight nausea, muscular pains, and a shrinking of skin nodules. Stippling of the red blood cells would appear, and an increase of lead in the urine and feces. We have repeated this in other patients with the same results so that unquestionably lead, at least in these patients, could be immobilized by this procedure. We have found that the pH of the urine has no relation to that of the blood. Considerable work on blood pH under different conditions is now being carried out in our laboratory and will be reported later.

THE RELATIVE VALUE OF RADIUM IN THE TREATMENT OF CANCER*

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IN RECENT years there has been a marked awakening of interest concerning the value of radium in malignant diseases, so much so that both here and abroad, activities have been instigated to establish centers where large quantities of radium can be made available. The incidence of neoplastic diseases has increased in sharper outline, as other chronic diseases of not as far-reaching economic importance have gradually lessened. This social problem involves not alone humanitarian aspects, but also presents another phase, which has as yet not been sufficiently stressed. That is, it affects an individual, and indirectly his dependents, at the time of his greatest economic value. This makes it of paramount importance for us as cancer students to realize the want of a specific therapy in this particularly harassing malady.

It is this increasingly evident situation which has prompted me to indicate what appears to me to be the immediate problem. For this reason, it is timely to evaluate radium in the treatment of cancer in relation to the formally accepted and orthodox methods. In the main, this discussion is not offered in the sense of a criticism of either one method or the other, but rather in the form of an unbiased analysis of the results achieved by surgery in its selected cases, and those obtained by radium and the radioactive agents.

To begin with, there is still a lack of general agreement on what is the proper conduct of a given case of cancer. There are, however, one or two phases of this problem which have received careful attention. This applies particularly to cancer of the uterus. In this group especially, the newer concept of the effectiveness of radium has replaced the former surgical procedure. Despite the convincing statistics from the larger clinics abroad and from important medical centers here, it is astounding that every now and then surgeons and gynecologists persist in subjecting cancer of the uterus to a high operative mortality, with no better prognostic outlook in view than is obtained by the use of radium. This holds true not only in the inoperable cases, but in the early and borderline cases of carcinoma of the cervix.

As a whole, though, it is highly commendable that the large majority of cancer workers recognize this comparatively new concept. In this type of malignancy throughout almost all the larger clinics the figures of five year arrest of the disease run fairly uniform, ranging approximately from 18 to 22 per cent.

In sharp contrast to the general agreement of the end-results obtained in cancer of the uterus is the uncertainty of various observers as to the percentage of operability. In the opinion of most writers, 18 per cent represents the average operability rate of cancer of the cervix, while others submit the almost unbelievable proportion of 70 per cent and, in one instance, 81 per cent. This division of opinion calls for further criteria and more careful study as to what constitutes real operability. As a matter of fact, the ablest surgeons and gynecologists have conceded that in cancer of the cervix at all stages, radium offers greater promise of cure than any other known method of treatment, and without attending operative risk.

In this connection, it is worth while to call attention to the newer information of the radiosensitivity of different forms of tumors. The clinically highly malignant

* Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8–9, 1929.

type, which by surgical procedure gives bad prognosis at best, proves to be very sensitive to radioactive substances, and therefore results in a high percentage of cures in the very group where surgery proves so helpless. These more recent studies have opened up an entirely new field, as they point to the wide differences of various tumors in their reactions to radium. The fact that tumors which exhibit highly malignant characters clinically react favorably to radium has made possible a new guide to classify most of the well-known tumors according to their radiosensitivity.

Rapid rate of growth and high metabolism of a tumor are prominent features in the favorable reaction to radium. As a rule, rapidly multiplying tissue possesses a high rate of metabolism, and generally these two go hand in hand. If, in addition to these, there exists increased vascularity in the tumor, then radiosensitiveness is markedly enhanced. Upon this basis alone tumors have been classified according to their degree of sensitivity, without regard to any other factor.

If I have particularly stressed the unanimity of the viewpoints held in cancer of the cervix, it was for the purpose of emphasizing the confusion and differences of opinion apparent in cancer of the breast. My own attempts to analyze the end-results in carcinoma of the breast convince me that a great deal of further study is necessary to clear up the perplexing situation in this group of cases. It is rather disappointing to find that in one clinic 60 per cent of all breast cancers are considered operable. Such a high rate of operability is difficult to conceive, when one-half to two-thirds of the operated cases present themselves with recurrences in the scar or field of operation one or two years after the primary operation.

This confusion is brought about by the conflicting reports, which vary from 15 per cent operability in some clinics, to 63 per cent of operability in others. So, too, statistics published from various sources leave a rather unsatisfactory impression. For instance, Döderlein, Finsterer and others report five year cures of approximately 5 per cent in cancer of the breast where glands are involved, while other writers report from 19 to 39 per cent five year cures. In breast cancer without involvement of the lymph nodes, figures reported run anywhere from 46 to 100 per cent five year cures. These indefinite statistics disclose quite a chaotic situation in such an important subject. "Surgery," says Finzi, "has had so long an inning, and the procedure has become so standardized that statistics should be fairly definite." So the less said the better.

No wonder, then, that the views submitted by the various writers as to the efficacy of radiotherapy in this field are equally at variance. At this period of writing, I am at a loss to interpret intelligently just what has been accomplished by the highly perfected surgical technique in this very group of cancer, which to all intents and purposes should offer the most favorable setting for a complete surgical eradication of the disease. First of all, it should be the most easily recognizable cancer. Secondly, it lends itself to complete excision of the tumor and that of the neighboring tissue, with very little surgical risk.

It is difficult to understand then that in the face of these clinical advantages modern surgery fails to furnish clear-cut information of definite prognostic value. There is something strange when one clinic reports such unsatisfying figures as 5 per cent five year cures, in contrast to others where figures range as high as 40 per cent. To attempt to compare the end-results obtained by radiotherapy in this group of cases is obviously unfair, and tends to make this matter much more involved. To again quote Finzi: "The material with which we have had to deal is so bad, that our results cannot be good. There is no question but that we should be supplied with a better type of case."

From what has already been stated, it seems clear that it should first be definitely settled that the results in cancer of the breast from operative treatment are disappointing and unsatisfying. When we confront the problem with an open mind and critical judgment it becomes of intense interest that prognostic results obtained before and since the advent of modern surgical technique are no better now than before, and this should cause us to view the matter with much concern. It would appear then, that the effectiveness of extensive excision of the tumor should be particularly reflected in this very type of malignancy.

According to my interpretation, these incontestable facts manifestly indicate that a change of attitude is necessary. On the basis of results reported here, it is my conviction that the radium specialists must exert a strong plea to submit comparable cases to establish the effectiveness of radium in this very group. It was through the efforts of the gynecologists themselves when they submitted uterine cancer to radium and roentgen therapy that definite facts as to the true worth of these agents were ascertained. In a few quarters where primary cancer of the breast has been submitted for radiotherapy, satisfactory data are reported. In Wintz's clinic all tumors of the breast are first treated by roentgen rays and radium. After an interval of two to three months, if the tumor has not been satisfactorily controlled, a local excision of the tumor is performed. Rarely is a second treatment administered, and then only after six months to a year.

Similar procedures with gratifying results are the routine in other clinics, though larger clinical material is necessary to arrive at definite conclusions. My own personal experience in primary tumors of the breast has encouraged me to stress and advocate the use of radium in these cases. To quote Finzi again: "The use of radium needling in earlier cases has shown marked improvements in the results, and such methods followed by extirpation, if desired, seem to offer a better chance of cure than operation with subsequent irradiation. On the other hand, prophylactic irradiation must not be withheld when operation is the method preferred. So long as surgical removal of cancer is a recognized method of treatment, irradiation must also find a place."

From the literature one gains the impression that the ablest surgeons are discouraged by the disappointing results of their best effords and begin to lean upon the future of the radioactive agents. The strongest support is gained from the newer studies of the favorable reaction of highly malignant tumors to radium and roentgen rays. Here again, as in cancer of the uterus, the extremely cellular form of tumor which gives a bad prognosis surgically, proves to be radiosensitive to a high degree, so that a good proportion of cures is obtained from irradiation. Under these conditions it is difficult to understand why there still should be controversy upon the need of radiotherapy.

Practically all reports from reliable observers, with one or two exceptions, cite greatly increased percentages of five year cures when roentgen rays and surgery were combined in the treatment of these cases, without taking into particular account the biological and histological variations of the tumor itself. For a clearer understanding of these varying factors, it is requisite that less importance be given to the anatomical classification and more to the sensitivity of the tumor to radium.

Entirely too much misunderstanding exists concerning the cellular differentiation of the tumor. The ingenious classification of Broders, and also of MacCarty, would be of greater value if the tumor exhibited the same cellular picture throughout its entire structure, and furthermore, if we could be certain that the architecture of the cells remained the same throughout the progress of the disease.

After what has just been said, it would seem a fair inference that radium in the treatment of cancer has won an uphill fight for recognition. The usefulness of radium in cancer of the cervix has been reflected through several years of experience with a marked degree of success, and is fairly well recognized as a method of efficiency and a fair degree of accuracy in definitely selected and early cases. In the inoperable cases it has more than held its own when compared with other recognized methods of treatment. All statistics support a record of approximately 10 per cent five year cures of what were formerly considered advanced and hopeless cases.

The far-reaching discussion of the problem of cancer of the breast has engaged the attention of most of the outstanding writers, but no definite conclusions have been arrived at up to the present. In spite of the various investigations, the end-results from surgery are far from clear cut, and a most perplexing situation exists, as most essential information is missing. On the other hand, public interest makes it desirable to ascertain how great a field of usefulness radium has in the group of malignant tumors of the breast. My own personal experience coincides with that of the more recent writers, who have described with painstaking care the end-results in a fairly large series of cases of cancer of the breast treated with some form of radium therapy, where operative procedures were omitted.

It is apparent that the ablest surgeons, not satisfied with their surgical results in breast cancer, have experienced a change of attitude towards agents other than surgery. In the main, there appears to be a division of opinion as to what is the proper thing to do in a given case of cancer of the breast. The work of the past few years, however, where primary breast cancers have been treated by irradiation alone, explains satisfactorily to those conversant with the situation, that the skillful and intelligent use of radium will compare favorably with any other form of treatment. The present work aims to cooperate in the solution of the problem of cancer of the breast. Handley says: "Each step in advance has required for its verification and establishment a period of about six years."

In closing, I cannot improve upon the words of Geoffrey Keynes, who says: "If, therefore, a method other than operation is adopted, it will not find itself in competition with any very efficient method of treatment, and results will be bad indeed if they are worse than those of operation."

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SARCOMA OF THE PROSTATIC AREA IN AN INFANT AGED FOUR MONTHS

CASE REPORT

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PRECEDENCE and previous experience of others, as described in textbooks and other literature, allow us to formulate therapeutic procedures rather readily in the average case, but in rare cases experiment is not always willingly accepted by the patient and relatives, and as a consequence the autopsy findings permit an opportunity for rather careful retrospect.

In previously reported cases of this type, in at least 50 per cent of the total number, surgery constituted the only means of treatment, and surgical procedures also served to make the diagnosis possible. In this particular instance preoperative information was sufficient so that it might have been possible to employ radiation, and it is for this reason that we call attention to the history, incidence, diagnosis and symptoms, in the hope that other cases of this type may at least have the benefit of less drastic procedures.

The incidence of sarcoma of the prostate between 1839 and 1926 is reported as follows: From the time of Stafford,[2] who reported the first known case, to 1926, when Kretschmer[6] surveyed the subject, reporting 80 cases, we find that several others have made surveys which probably overlap, and we may estimate the total number to be about 100. Among others who have studied the literature are Young, Kaufmann, Ewing, Bumpus, Culver, Kline, Concetti, Deming and O'Neil. Deming,[5] in 1924, in a rather exhaustive article, quotes about 65 cases from a rather complete bibliography, and states that sarcoma comprises about 56.9 per cent of these cases. This classification includes sarcomata, myxosarcoma, fibrosarcoma and lymphosarcoma. Myxosarcoma constitutes 25 per cent of the cases, fibroma about 7 per cent, with an occasional myoma, rhabdoma, fibroma, papilloma, polyp and dermoid. Angiosarcoma and chondrosarcoma have also occasionally been reported.

The average incidence shows that out of a total of 252 primary bladder tumors reported by Albarran in all ages, 211 occurred in the male and 41 in the female, and that only 6 are reported previous to the age of ten years, while the great majority occurred at the age of about four or five years. One of the earliest of which we find record is that of a sarcoma of the bladder in a girl of eleven months, reported by Concetti.[3]

CASE REPORT

Patient, Harry G., white, aged four months,

Family History. Father, aged twenty-eight, living and well; mother, aged twenty-five, living and well. One brother died at six weeks of age with what family physician termed uremic fever (child was swollen all over and passed no urine two days before death). Parents give no history of venereal disease. No cancer history in family. Both children were delivered normally and in each the period of gestation was normal. This baby weighed 6½ pounds at birth and had grown to 14½ pounds at three months. Never sick during this time.

Present Illness. One month ago, mother noticed that child strained and became very red in the face during bowel evacuation. She found that instead of the baby passing fecal matter it was forcing out urine, a few drops at a time. The mother reported this to the family physician, who suggested that the baby was teething and its bowels were upset. On Jan. 24, the baby was very fretful and the mother thinking of intestinal colic, began massaging the baby's abdomen. She discovered a swelling in the region of the bladder and called the

family physician, who administered spirits of nitre and said, "Tumor would go as it came." The tumor increased in size and hot applications were applied. The baby was brought to Miami in the late afternoon to Dr. Charles Kennon, a pediatrician, who made an effort to catheterize the bladder, but having failed, referred the case to us. Efforts to pass soft rubber and ureteral catheters into the bladder failed. A filiform was then successfully passed and the child in its fretful crying voided a small amount of urine around the filiform. A No. 12 sound was then attached to filiform and carried into bladder. Upon withdrawal, the baby was still unable to empty the bladder. Efforts to pass catheters again failed, in spite of urethral dilatations from sound. A roentgenogram was then made to rule out the possibility of stone in the bladder. The films revealed an enormously distended bladder, reaching a finger's breadth above the umbilicus. No calculi were demonstrated on the film. A small hollow metal tube was then bent in the shape of a prostatic catheter, and another attempt made to enter the bladder with this devised instrument. Passing a grating obstruction in the posterior urethra, the metal catheter slid over the prostatic obstruction and into the bladder. With the improvised catheter anchored and a small rubber tube attached to the distal end so that a forceps control might be established, 700 c.c. of urine was evacuated during the next fourteen hours, by means of interval decompression. The tube was removed the following morning when evacuation was complete. In the afternoon of that day the child was brought for relief again, it having been unable to void in the interval since the tube was removed. At this time a No. 6 ureteral catheter on a stilet was introduced into the bladder and anchored there as a retention catheter. Three days later when we deemed the baby had sufficiently recovered from the acute urinary retention, a cystogram (using sodium iodide) was made, and the films revealed two distinct laterally placed lobes projecting from the prostatic area into the bladder and clearly separated by the catheter lying in the median line (Fig. 1). A rectal examination was made, using the little finger, and the tumor in the prostatic area was definitely outlined. With the finger carried high in the rectum so as to examine the retrovesical space, none of the tumor growth was palpated. A diagnosis of tumor in the prostatic area producing vesical neck obstruction was then made.

On Jan. 30, while still considering the most feasible treatment of this case, the child's temperature suddenly went to 105°F. and showed distinct signs of acute sepsis. It was decided to do a suprapubic cystotomy immediately to provide more ample drainage.

Fig. 1.

Operation. On opening the bladder under general ether anesthesia and exposing the vesical neck, the prostatic lobes were seen to protrude into the bladder and several small pedunculated polyps were hanging through the sphincter with their attachments apparently in the posterior urethra. Careful palpation of the bladder mucosa disclosed no abnormal tissue. It was impossible to obtain a frozen section of a portion of the tumor at the time. An examination of the posterior urethra by the little finger disclosed the fact that the tumor in the prostatic area could be easily enucleated. Believing that the only chance of saving this child's life was by removing the obstructing tissue, the operator proceeded to do a complete

prostatectomy. This having been done, a search with the examining finger was made of the retrovesical space to determine if any of the tumor growth was situated in that region. Satisfied that the growth did not extend in this direction, the prostatic area was packed with gauze, a drainage tube placed in the bladder, and the bladder, muscle and skin closed in the usual manner.

Pathological Reports. "Prostatic area mass submitted, consisted of two nodular masses measuring 20×15×30 mm., respectively, total weight 12 gm. Surfaces appear smoothly encapsulated except for several long string-like tags to one.

"Cut surface white, glistening, soft, homogeneous.

"Formalin-fixed, paraffin sections, stained with hematoxylin and eosin show glandular structures simulating prostatic acini widely separated by rather polymorphous-celled myxomatous tissue with stellate and spindle cells showing anastomatic processes. I should interpret this as myxosarcoma of the prostate." (Submitted by Dr. W. P. Stowe, Jackson Memorial Hospital.)

"The sections of tumor of the bladder in an infant show a definite structure of myxosarcoma. The cells are spindle, small and large, very hyperchromatic, often packed together with a little stroma in very cellular areas, and sometimes associated with much myxomatous material. In several places I find well-developed striated voluntary muscle, which I think can be traced to the tumor cells, since all stages in the growth of these muscle cells are to be observed. Some of them are nearly adult muscle cells, while others are merely small globules of acidophile cytoplasm. The acini of the gland seem to participate in the tumor process in some areas, but not in others.

"The tumor is malignant and a recurrence not improbable.

"Myxosarcomas of the prostate are well known, and I have seen others at this very early period of life." (Submitted by Dr. James Ewing, Cornell Medical School.)

Progress of Case. After a stormy period of several days, the child began to make splendid progress and on Feb. 12, the bladder was practically closed and the infant was voiding through the normal channel. On Feb. 18 the child began to show definite uremic symptoms, a twitching of the arm and leg muscles, fever, and vomiting of food. As the quantity of urine was decreasing, we feared a recurrent bladder neck obstruction, but upon catheterizing the bladder found it empty. What few drops of urine we did collect showed casts and albumin. Intraperitoneal infusions, proctocylcies, etc., were of no avail, and on Feb. 22 the child died.

Autopsy Report. "Kidneys appear normal for age except for some swelling and dilatation of kidney pelves. Ureters are greatly dilated. At the ureteral mouths on both sides, beneath the the mucosa and surrounding both mouths are masses of white tissue about 1.5 cm. across.

"Microscopic sections of these nodes show, between the muscle fibres of the bladder, infiltrating sheets and masses similar to the stromal tissue of the original prostatic neoplasm.

"Examination of spleen, lungs, and liver shows normal organs with no metastasis.

"Diagnosis: Extension of prostatic myxosarcoma. Hydroureter and hydronephrosis bilateral."

Comments. In addition to the fact that this probably represents one of the youngest cases of sarcoma of the prostatic area, it is interesting from the fact that the information obtained before operation will serve to restrain too hasty surgery in other instances of this type. In our discussion we felt that the alternative in diagnosis was that of polypoid growths. The advisability of irradiation was discussed, but we were of the impression that delay in relieving the retention was not justified, and in addition we were not at all certain of our differentiation with relation to the benign or malignant character of these masses. In the cases which Deming reports irradiation was used in one instance, together with diathermy, but even then a recurrence within six weeks was evidence that the treatment had been inadequate, therefore, resection was again resorted to. Total cystectomy has been advised by Albarran[7], and again by Darling in 1925. One case which he reports lived longer after operation than any other patient with myxoma, but whether the tumor was at all retarded by excision and

irradiation is still problematic. In discussing this particular case with Dr. Bloodgood, his advice was that irradiation should have been used to save life, even at all costs to other sequelae. This had been explained to the patient's parents, but was not acceptable. We felt particularly gratified that the diagnosis of tumor of the prostatic area in extreme infancy has been made by cystographic methods, and we believe that it is a definitely indicated diagnostic procedure in all cases of this type. It might have been of interest to make ureterograms early in the course of the disease, to give us information as to the degree to which these ureters may be dilated in infants.

There is a slight disagreement of opinion with reference to the etiology or histogenesis of this tissue. We note that this has also occurred in the previously reported cases.*

* We wish to express our thanks to Drs. Ewing and Stowe for their interest in the pathologic specimens, and to Dr. Bloodgood for his advice, as well as to Drs. Holmes and Coplan for their cooperation in reporting this case. It will undoubtedly appear in the urologic journals under their authorship.

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DR. W. D. COOLIDGE
Caldwell Lecturer, 1930

IV OF MICH.

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Sixteenth Annual Meeting: 1931, to be announced.

Committee on Arrangements: R. E. Loucks, Chairman, 337 W. Grand Blvd., Detroit, Mich., R. H. Stevens, Detroit, Mich., L. B. Ashley, Detroit, Mich.

EDITORIAL

THE FUTURE OF RADIOLOGY AS A SPECIALTY

WHENEVER radiologists gather together one is apt to hear expressions of apprehension as to the future of radiology as a specialty of medicine. The attitude of many hospitals toward radiology and the radiologist, the more or less extensive use of roentgen rays and radium by other specialists and by general practitioners, and the commercial laboratory problem are all cited as evidence of the precarious position which radiology occupies.

Perhaps a consideration of the genesis and evolution of medical specialties would to a large degree mitigate the radiologist's misgivings, and also point the way to a better shaping of his destinies.

It is not necessary for our purpose to go into the genesis of specialization further than to state that it is a natural response to a general demand that all available knowledge be properly used and applied. Everyone recognizes that something is gained and lost in the process, but if not carried to extremes it more nearly meets the demands of the situation than anything we have to offer.

Once launched, a specialty goes through certain changes before it becomes stabilized and permanently adjusted to medical practice as a whole.

In the earlier stages of its evolution its fate rests entirely with the medical profession. The pioneer in a new specialty is usually entirely dependent on the patronage of practitioners in other fields and under such circumstances is apt to be regarded more or less patronizingly by them. He is expected to confine his activities within narrow bounds, even though his patrons, who may themselves be specialists, practice their art along much broader lines. The duration of this period of professional domination will depend on varying circumstances, but sooner or later if the new specialty is to survive it will enter upon a period of transition during which its fate passes beyond the determination of the profession as a whole, finally to become vested in the public. This readjustment takes place so gradually that the participants in it do not realize that it is occurring. Patients begin consulting the specialist on their own initiative. His colleagues in other fields will doubtless continue to refer patients to him, but with this added incentive, that the patient expects it, and in the ordinary course of events would likely go to him anyway. It ultimately transpires that the specialist finds himself referring about as many patients to other physicians as they refer to him. When such a reciprocal relationship has been established the specialty may be said to have become stabilized, and thereafter its fortune will depend largely on the measure of public respect and esteem it may be able to command.

All of the evolutionary processes sketched above can be traced in the development of radiology as a specialty. That it has not as yet reached a state of complete stabilization is quite apparent, but that it will do so eventually seems assured, and the lines along which it will be accomplished are plainly evident. In the past the radiologist has quite naturally been primarily solicitous of the patronage of physicians in other fields, as was, and still is, natural and proper. It is certain, however, that he has not taken advantage of his opportunities to encourage public favor and thereby establish a clientele of his own upon which his ultimate status will de-

pend. He has narrowed his field of endeavor to unreasonable limits, and has so detached himself from what we ordinarily understand as the practice of medicine that many of them know very little about the relationship of doctor and patient that obtains in every other department of clinical medicine. It is questionable, indeed, if the radiologist who spends the major portion of his time running hither and yon "reading films" has much more justification for styling himself a practitioner of medicine than has a proof reader to style himself an author. The principles of "mass production" of which we hear so much in the industrial world cannot be successfully applied to radiology or any other branch of medicine.

It is fortunate for radiology, that throughout its vicissitudes, many of its leaders have maintained their status as practitioners of medicine in every sense of the word, and that they are not only highly regarded as consultants by their professional colleagues, but by an ever increasing clientele outside the profession. With a maintenance of such leadership a bright future for radiology is assured, and to young men with proper background it offers splendid opportunities.

T. A. Groover

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-first annual meeting: West Baden Springs Hotel, West Baden, Indiana, Sept. 23–26, 1930.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles. Calif.
Annual Meeting, 1931, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting, 1931, to be announced.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.
Sixteenth annual session: Los Angeles, Calif., Dec. 1–5, 1930.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Robert A. Arens, Michael Reese Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, Fisher Building,
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary. Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L, G. Rigler, University Hospital, Minneapolis, Minn.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston. Mass,
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr Robert E. Pound, Fifth Avenue Hospital.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Missouri Building
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY
Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Next meeting, Norfolk, Va., 1 P.M., Wednesday, Oct. 22, 1930.

CUBA

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GE SELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖENTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. O. Wissing, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

THE ANNUAL MEETING

The Thirty-first Annual Meeting of the American Roentgen Ray Society will be held at West Baden Springs, West Baden, Indiana, from September 23 to 26, inclusive, 1930.

West Baden Springs is situated in the beautiful Lost River Valley of southern Indiana, about thirty-five miles from the center of population of the United States, thereby making it accessible from all portions of the country. It is reached by the Monon and Southern Railroads and by five state and national hard-surfaced highways from Chicago, St. Louis, Indianapolis, Cincinnati, Evansville and Louisville, and there is through Pullman service from New York, Chicago, St. Louis, Cincinnati and Memphis. Any railroad ticket agent will supply detailed information as to the best railroad routes to take in reaching West Baden.

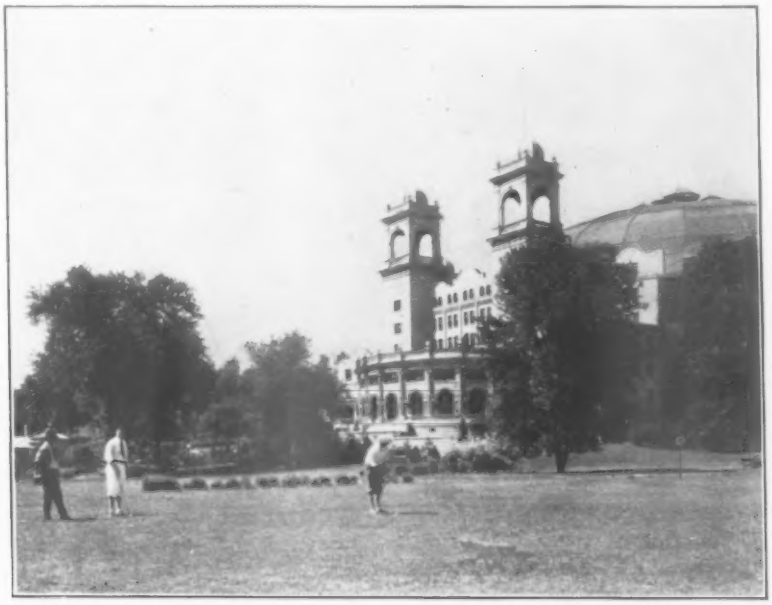
The convention is to be held in the West Baden Springs Hotel which offers every facility for an ideal meeting place, as the physical equipment is such that all of the assembly halls and exhibit rooms are under the same roof and there is ample room in the same hotel for the accommodation of the entire membership of the Society and their guests. In addition to the physical equipment of the hotel, which is splendid, there are opportunities offered for all sorts of entertainment including outdoor sports, such as horseback riding and golf. It was the purpose of the president-elect and his committee to arrange the program so that the members would have ample opportunity to enjoy the variety of entertainment offered by the hotel.

While no specific entertainment is planned for the ladies it was thought that the usual recreations offered by a summer resort hotel would be sufficient to assure the wives and children of members a pleasant vacation and the Society extends them a cordial invitation to attend the meeting.

The rates at the hotel are those usual at a resort hotel and it is urged that those contemplating attending the meeting make their reservations as soon as possible.

The railroads have granted reduced rates to the Society but the members must obtain a certificate at the time they purchase their tickets and it is urged that each member do this so that sufficient number of certificates will be obtained to permit of the rebate.

For those who anticipate driving to the convention the routes from the various cities are given. While it is believed that these routes are accurate, it is suggested that those who anticipate driving check them through their local automobile clubs.



A View of West Baden Springs Hotel

ROUTES TO WEST BADEN

From

Chicago—U. S. Rd. 41 to junction with U. S. Rd. 52 thence on Rd. 52 to Indianapolis—then Rd. 37 to Paoli—Rd. 56 to West Baden.

St. Louis—U. S. Rd. 50 via Vincennes, Washington to junction with U. S. Rd. 150 and Rd. 56, on Rd. 56 to West Baden. (Eight mile detour at present time, over good gravel road.)

Detroit—U. S. Rd. 112 to Coldwater then U. S. Rd. 27 via Angola to Fort Wayne thence U. S. Rd. 24 to Huntington—Rd. 9 to Anderson—Rd. 67 to Indianapolis—Rd. 37 to Paoli—Rd. 56 to West Baden.

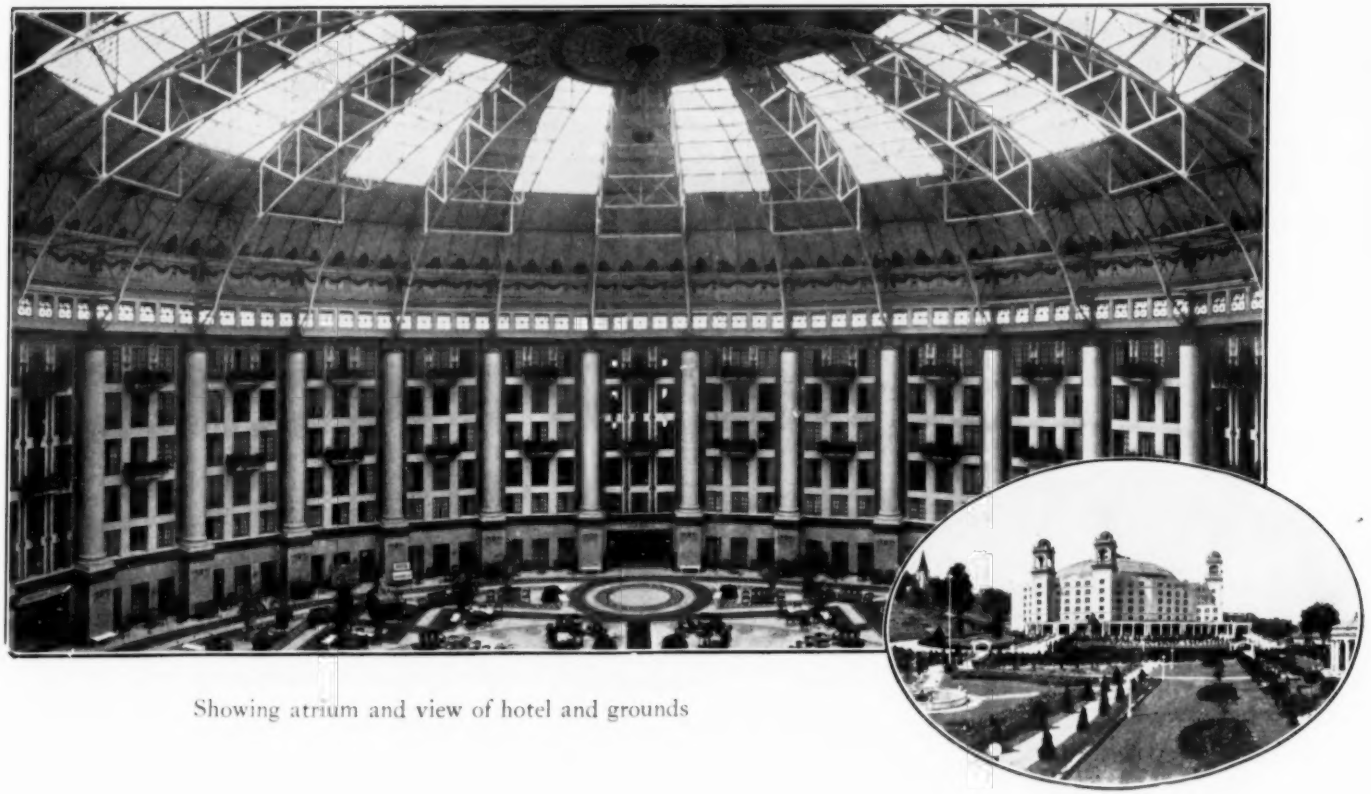
Or,

Detroit—U. S. Rd. 25 to Toledo—U. S. Rd. 24 to Defiance—Rd. 18 to Hicksville thence paved county road to Fort Wayne—then follow above route from Fort Wayne via Indianapolis to West Baden. (Either route all paved.)

Cleveland—U. S. Rd. 42 to junction with U. S. Rd. 40 thence on Rd. 40 to junction with Rd. 201 via Dayton—Rd. 11 to Eaton—Richmond thence U. S. Rd. 40 to Indianapolis—Rd. 37 to Paoli—Rd. 56 to West Baden. (Detour on U. S. Rd. 40 in Ohio east of Ind.-Ohio line.)

Cincinnati—U. S. Rd. 50 to Versailles—Rd. 29 to Madison—Rd. 56 to Scottsburg—U. S. Rd. 31 to New Albany—Rd. 62 to Junction with Rd. 35—then Rd. 35 to Palmyra—U. S. Rd. 150 to Paoli, Rd. 56 to West Baden. (Rd. 62 and Rd. 35 is used as the detour for Rd. 150 from New Albany to Palmyra.)

Atlanta—U. S. Rd. 41 via Chattanooga to Nashville—thence Rd. 6 and U. S. Rd. 31 to Louisville (all paved except few miles in



Showing atrium and view of hotel and grounds

Kentucky) thence to New Albany—Rd. 62 to junction with Rd. 35—then Rd. 35 to Palmyra—Rd. 150 to Paoli and Rd. 56 to West Baden. (Nashville via Louisville—296 miles.)

NASHVILLE—U. S. Rd. 41 to Evansville—Rd. 62 to junction Rd. 45 then Rd. 45 to junction Rd. 56 then Rd. 56 to West Baden. (Nashville via Evansville—269 miles.)

PROGRAM

AMERICAN ROENTGEN RAY SOCITEY

TUESDAY, SEPTEMBER 23, 1930
9:30 A.M.

Diagnosis of Extra-bowel Pathology. P. F. Butler, M.D., Boston, Massachusetts. Discussion to be opened by John Sproull, M.D., Haverhill, Massachusetts.

Epiphyseal Tuberculosis of the Spine. Howard P. Doub, M.D., and Carl E. Badgley, M.D. (by invitation), Detroit, Michigan. Discussion to be opened by E. S. Blaine, M.D., Chicago, Illinois.

Further Observation on the Treatment of Superficial Malignancy. G. W. Grier, M.D., Pittsburgh, Pennsylvania. Discussion to be opened by G. E. Pfahler, M.D., Philadelphia, Pennsylvania.

The Roentgen Ray Toleration Dose for the Myocardium of Rats. Aldred S. Warthin, M.D., Ann Arbor, Michigan (by invitation), and Ernst A. Pohle, M.D., Madison, Wisconsin. Discussion to be opened by H. P. Doub, M.D., Detroit, Michigan.

The Roentgenologist in Industrial Surgery. E. C. Samuel, M.D., and E. R. Bowie, M.D., New Orleans, Louisiana. Discussion to be opened by Stanley Clark, M.D., South Bend, Indiana.

TUESDAY, SEPTEMBER 23, 1930
2:00 P.M.

Technique and Differential Roentgen Diagnosis of Carcinoma of the Pelvic Colon. James T. Case, M.D., Chicago, Illinois. Discussion to be opened by George W. Holmes, M.D., Boston, Massachusetts.

A. A Method of Infant Posture Fixation.

B. A Posture Instrument for Lateral Exposure of Cervical Spine.

C. A Radium Applicator for the Tonsil.

D. High Voltage X-Ray Therapy of the Pelvis through the Perineal Port. David R. Bowen, M.D., Philadelphia, Pennsylvania.

Opaque Oil in Maxillary Sinus Disease. R. C. Beeler, M.D., L. A. Smith, M.D., and J. W. Collins, M.D., (by invitation) Indianapolis, Indiana. Discussion to be opened by Frederick M. Law, M.D., New York.

A Clinical Evaluation of Variable Qualities of Roentgen and Radium Rays for the Treatment of Cancer. Bernard P. Widmann, M.D., Philadelphia, Pennsylvania. Discussion to be opened by Howard E. Ruggles, M.D., San Francisco, California.

The Nasal Accessory Sinuses: Roentgenographic and Clinical Observations. Bundy Allen, M.D., Tampa, Florida. Discussion to be opened by J. Brown Farrior, M.D., Tampa, Florida.

Automatic Polarizer for Synchronous Rectifier. Robert B. Taft, M.D., Charleston, South Carolina. Discussion to be opened by David R. Bowen, M.D., Philadelphia, Pennsylvania.

TUESDAY EVENING, SEPTEMBER 23, 1930

William Conrad Roentgen and the Discovery of the Roentgen Rays. Otto Glasser, M.D., Cleveland, Ohio.

Early Roentgen History. E. H. Skinner, M.D., Kansas City, Missouri.

WEDNESDAY, SEPTEMBER 24, 1930
9:00 A.M.

Pneumoconiosis (Silicosis).

(a) The Pathological Characteristics. H. K. Pancoast, M.D., Philadelphia, Pennsylvania.

(b) The Roentgenological Aspects. E. P. Pendergrass, M.D., Philadelphia,

Pennsylvania. Discussion to be opened by M. J. Hubeny, M.D., Chicago, Illinois.

X-Ray Diagnosis and the Roentgen Therapeutic Results in Lymphosarcoma of the Mediastinum and Lungs. Webster W. Belden, M.D., and John Remer, M.D., New York, New York. Discussion to be opened by Rollin H. Stevens, M.D., Detroit, Michigan.

A Discussion of the Occurrence of Benign Ulcer on the Greater Curvature. John Sproull, M.D., Haverhill, Massachusetts. Discussion to be opened by Fred M. Hodges, M.D., Richmond, Virginia.

Subject to be announced later. William Gregory Cole, M.D., New York, New York, (by invitation).

Is Irritation a Cause of Cancer? Arthur W. Erskine, M.D., Cedar Rapids, Iowa. Discussion to be opened by U. V. Portmann, M.D., Cleveland, Ohio.

WEDNESDAY AFTERNOON
SEPTEMBER 24, 1930
2:00 P.M.

Gallstone Obstruction of the Duodenum. A. W. Crane, M.D., Kalamazoo, Michigan.

The Roentgen Management of Chronic Leukemia. Ross Golden, M.D., K. R. McAlpin, M.D., (by invitation), and Katherine S. Edsall, B.S., (by invitation), New York, New York. Discussion to be opened by Charles L. Martin, M.D., Dallas, Texas.

Lesions of the Diaphragm. E. L. Jenkinson, M.D., Chicago, Illinois. Discussion to be opened by B. R. Kirklin, M.D., Rochester, Minn.

Pulmonary Tuberculosis: Errors in Differential Diagnosis. (Lantern Demonstration). Leon T. LeWald, M.D., New York, New York. Discussion to be opened by George W. Holmes, M.D., Boston, Massachusetts.

Roentgen Observations on the Movement of Pleural Effusions: Leo G. Rigler, M.D., Minneapolis, Minnesota. Discussion to be opened by W. F. Manges, M.D., Philadelphia, Pennsylvania.

Blood Changes in the Lymphomata and the Leukemias and their Bearing on Roentgen Ray Therapy. Raphael Isaacs, M.D., Ann Arbor, Michigan. Discussion to be opened by W. Edward Chamberlain, M.D., San Francisco, California.

WEDNESDAY EVENING, SEPTEMBER 24, 1930

The Relationship between the Roentgenologist and the Surgeon in the Treatment of Diseases of the Stomach and Duodenum. D. C. Balfour, M.D., Rochester, Minnesota (by invitation).

Caldwell Lecture. The Development of Modern X-Ray Generating Apparatus. W. D. Coolidge, Ph.D., Schenectady, New York.

THURSDAY, SEPTEMBER 25, 1930
9:00 A.M.

The Value of the Roentgenological Examination in Pulmonary Tuberculosis. Lawrason Brown, M.D., Saranac Lake, New York, and H. L. Sampson, Trudeau, New York (by invitation).

The Treatment of Mixed Tumors of the Parotid Gland. E. A. Merrit, M.D., Washington, D. C., Discussion to be opened by Eugene Leddy, M.D., Rochester, Minn.

A Study of Forty-Two Cases of Melanosarcoma. William A. Evans, M.D., Detroit, Michigan. Discussion to be opened by George E. Pfahler, M.D., Philadelphia, Pennsylvania.

Tuberculous Atelectatic Cirrhosis of the Lung: Its Roentgenologic Significance. Karl Kornblum, M.D., and Richard T. Ellison, M.D., Philadelphia, Pennsylvania (by invitation). Discussion to be opened by L. R. Sante, M.D., St. Louis, Mo.

Malpractice Hazards of X-Ray and Insurance Against Them. H. F. Wanvig, New York, New York.

THURSDAY AFTERNOON
SEPTEMBER 25, 1930

Congenital Idiopathic Hypertrophy of the Heart with the Roentgen Findings in Two Cases. George W. Holmes, M.D., Boston, Massachusetts. Discussion to be opened by A. W. Crane, M.D., Kalamazoo, Michigan.

Further Studies in the Application of Intravenous Cholecystography and Liver Function Determination as Employed in Office Practice. Charles A. Waters, M.D., and Whitmer B. Firor, M.D. (by invitation), Baltimore, Maryland.

Necessity for Accurate Technic in Oral Cholecystography and Error Attributable to Technical Failures. B. R. Kirklin, M.D., Rochester, Minnesota.

Five Years' Experience with Oral Cholecystography. Wm. H. Stewart, M.D., and H. Earl Illick, M.D. (by invitation), New York, New York. Discussion to be opened by C. D. Enfield, M.D., Louisville, Kentucky.

X-Ray Dosage. E. T. Leddy, M.D., Rochester, Minnesota.

FRIDAY MORNING, SEPTEMBER 26, 1930.

Radiation in the Treatment of Bone Tumors. George E. Pfahler, M.D., and Leo D. Parry, M.D. (by invitation), Philadelphia, Pennsylvania. Discussion to be opened by H. J. Ullmann, M.D., Santa Barbara, California.

Intravenous Urography. W. F. Braasch, M.D., Rochester, Minnesota (by invitation).

Uterine Hemorrhage Without Demonstrable Pathology. Charles L. Martin, M.D., Dallas, Texas. Discussion to be opened by James T. Case, M.D., Chicago, Illinois.

The Clinical Study of "Colitis" with Special Reference to So-called "Colitis." J. A. Bargen, M.D., Rochester, Minnesota (by invitation). Discussion to be opened by Harry A. Collins, M.D., Des Moines, Iowa.

Ollier's Disease, Unilateral Chondrodysplasia. Report of a Case. Ralph S. Bromer, M.D., and Rutherford L. John, M.D., (by invitation) Philadelphia, Pennsylvania. Discussion to be opened by C. S. Gorsline, M.D., Battle Creek, Michigan.

FRIDAY AFTERNOON, SEPTEMBER 26, 1930

The Roentgen Ray Diagnosis and Localization of Opaque Foreign Bodies in the Air Passages. W. F. Manges, M.D., Philadelphia, Pennsylvania. Discussion to be opened by George W. Grier, M.D., Pittsburgh, Pennsylvania.

Fractures of the Anterior, Superior Border of the Os Calcis due to Indirect Violence. H. W. Dachtler, M.D., Toledo, Ohio. Discussion to be opened by A. L. Gray, M.D., Richmond, Virginia.

Coccidioidal Granuloma: Roentgen Diagnosis. Ray A. Carter, M.D., Los Angeles, California (by invitation). Discussion to be opened by William B. Bowman, M.D., Los Angeles, California.

The Post Pneumonia Lung. Alan L. Hart, M.D., Director Radiological Department Tacoma General Hospital, Tacoma, Washington. Discussion to be opened by H. K. Pancoast, M.D., Philadelphia, Pennsylvania.

DR. HICKEY HONORED

The many friends of Dr. Preston M. Hickey will be interested to know that an honorary degree of Doctor of Science has been conferred upon him by the College of the City of Detroit.

A CORRECTION

In the June issue of the Journal, page 677, appears an abstract of an article by W. W. Wasson on "Bronchosinusitis Disease." The third from the last sentence reads: "The roentgenogram is not typical." The sentence should read: "The roentgenogram is typical."

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

AUTOMATIC ELECTRIC HORIZONTAL AND VERTICAL SERIALOGRAPH

By MOSES EINHORN, M.D.
NEW YORK CITY

THE serialograph, a device whereby several roentgen exposures are obtainable on a single film, has been in use now for the past few years. The various types are more or less identical in construction, permitting from four to twelve exposures to be taken on a film. All of these serialographs necessitate shifting the cassette upon the completion of each exposure.

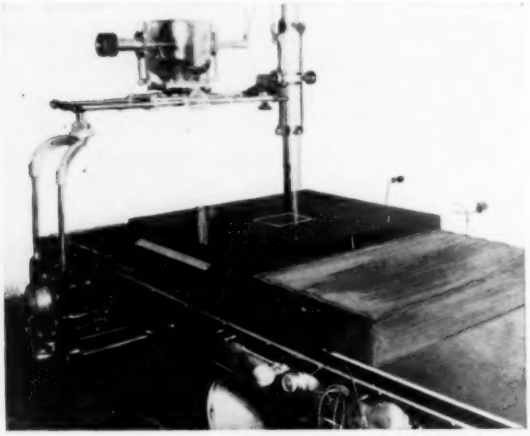


Fig. 1.

I have constructed a new serialograph (Fig. 1) which, unlike the others, is automatically operated. It consists of a standard size cabinet, supported by rollers, and can be fitted readily to any roentgen table. Handles attached to either side of the cabinet facilitate its movement to the desired position. The top of the cabinet is lined with lead, with the exception of a small square area 5×5 in. which is unlined, in order to permit a penetration of the rays. Protecting the entire surface is a thin layer of bakelite, with markings thereon, corresponding to the square area 5×5 in., uncovered with lead.

The cassette, 10×12 in., is introduced through a small aperture provided for that purpose on one side of the cabinet. It is held in position by a tray, constructed with a specially devised spring mechanism, which enables the tray to revolve. Beneath the tray is a metal disk, with four notches, each corresponding to one quarter of the circumference of the tray. A lever with a small projection at its outer end is attached to the base of the cabinet. This projection is held tightly to the side of the disk, by a wire spring, which is attached at one end to the lever, and at the other the other end to the disk. An electromagnet is placed behind the lever,

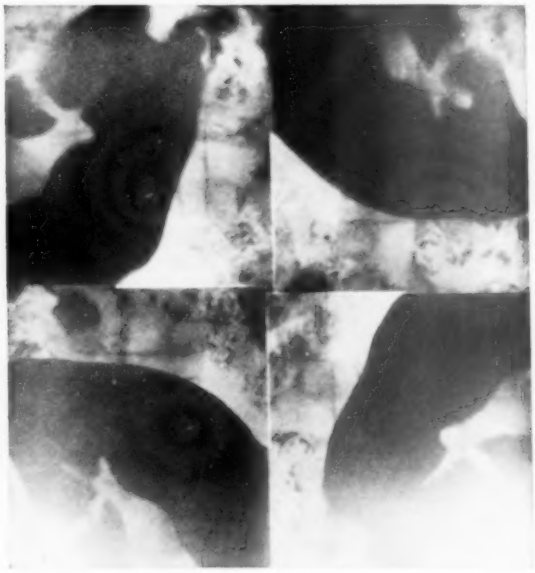


Fig. 2.

and is connected to an electric current.

Upon pressing a button from a distance, the magnet is electrified, which in turn pulls the lever, enabling the tray to revolve. As soon as the button is released, the current is broken, the magnet demagnetized, and the lever is drawn towards the disk by the attached spring. While the disk rotates, the projection at the outer end of the lever follows its course in the opposite direction, and upon reaching the first notch, causes the tray to stop revolving. Each time the button is pressed, the cassette revolves one quarter of its circumference, and automatically stops, bringing an unexposed quarter of the film directly beneath the marked surface of the cabinet. The entire system is connected with a bell circuit, which rings only while the mechanism is in motion. The vertical serialograph is constructed along the same principles as the horizontal, except that the film is taken vertically.

The model illustrated in Figure 1 is particularly useful in taking a series of exposures of the pylorus and duodenum (Fig. 2), and may also be used for other parts of the body. This model is designed for a standard cassette 10×12 in., permitting four exposures to be taken on a film. However, it can be modified to take eight exposures, by constructing the disk with eight notches, each notch corresponding to one-eighth of the circumference of the tray, with the unlined area in the form of a triangle, with an angle of 45 degrees and a diameter of 5 inches.

In operating the serialograph, it is necessary to employ a cushion on either side of the cabinet in order to add to the comfort of the patient. However, this model is merely experimental, and can be improved by reducing the cabinet several inches in height, thus eliminating the need of the cushions.

Advantages: (1) Shifting of the cassette is eliminated. (2) The apparatus is automatically operated at a distance. (3) The interval between each exposure is shortened.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

TESCHENDORF, WERNER. Über Stereo-Projektionen des Schädels. (On stereo-projections of the skull.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 17–34.

In a previous communication the author called attention to the fact that stereoroentgenograms are best obtained in slightly oblique positions. In the present article he discusses the method from the practical standpoint, as applied to the more or less standard positions of the skull.

It was found that in order to obtain a better stereo effect it is necessary to use certain landmarks. On the skull these consist of metal pieces mounted at regular (1 cm.) distances on bands, one of which runs circularly around the head; the second from the forehead to the occiput, and the third transversally across the head. The bands form a sort of a cap, similar to that used for eye-shades. Part of the frontal and occipital portions of the circular band is made of elastic rubber, so as to be able to fi the cap for various skull sizes.

A table is included for the technique of the following more or less standard examinations of the skull: canalis opticus, sella turcica (lateral and oblique), mastoid process, petrous bone (oblique and lateral), base of the skull (from above and below),maxilla and accessory sinuses. The article is illustrated with several roentgenograms fitted for the hand stereoscope.—*T. Leucutia.*

TALIA, F. Lo studio radiografico della sella turcica nelle metropatie emorragiche. (Roentgen study of the sella turcica in hemorrhagic metropathy.) *Arch. di radiol.*, Sept.-Oct., 1929, *5*, 841–852.

From 1925 to 1929 the author made roentgen examinations of the sella turcica in all patients who came to him for genital hemorrhage in order to determine whether such hemorrhages are hypophyseal in origin. He studied 41 cases, including 31 of hemorrhagic metritis, 7 of metrorrhagia and ovarian dysfunction and 3 of puberty metrorrhagia. He found that the sella turcica was larger than normal in 41.46 per cent of the cases, smaller than normal in 14.53 per cent, that it showed the maximum size in 4.87 per cent and the minimum size in 2.43 per cent. He gives the case histories of the 2 cases that showed maximum size of the sella turcica. Both were treated by roentgen irradiation of the hypophysis and both of them improved greatly under the treatment.

He concludes that there is a relation between the hypophysis and genital function, either directly by the size and function of the hypophysis influencing genital function, or indirectly of the nature of compensatory hypertrophy of the hypophysis in genital hemorrhage.—*Audrey G. Morgan.*

GOETTE, K. Über die Darstellung von Hirnbasiszisternen und deren diagnostische Verwentbarkeit. (The demonstration of the cisternae of the base of the brain and its diagnostic utility.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 1–7.

The author injected the cisternae of the base of the brain in cadavers (with a solution of gelatine barex) and compared the roentgen images so obtained with those of encephalograms.

It was found that the injection of the cisterna interpeduncularis and of the fissurae chorioideae has a certain practical value in brain tumors. In this respect the superimposed projection (in a true lateral view) of the fissurae chorioideae is of a true diagnostic value, inasmuch as it permits the detection of changes in size, form, and position of the fissures of the two sides.

It is advised that roentgenograms be taken in at least two positions: one in a strictly lateral, and the other in a slightly oblique position. The procedure of the encephalography (which is done by the cisternal or lumbar puncture) has previously been described by the author in another article. Here it is only mentioned that for a true lateral roentgenogram the patient must be placed in a sitting position with the head erect and the central ray must be directed through the hypophyseal region perpendicularly to the sagittal plane of the

skull. For the oblique position the head is turned with the face slightly away from the film. It is very important that the injection itself be done in the sitting position and that every motion of the skull following the injection be avoided.

In a series of 113 cases, 16 times there was an abnormal position and configuration of the choroid fissures. Two of these cases are described briefly and their roentgenograms presented.—*T. Leucutia.*

Bustin, E., Leist, M., and Priesel, R. Röntgenologische Studien am kindlichen Gebiss. II. Das normale kindliche Gebiss vom Durchbruch der Sechsjahr-Molaren bis zum Durchbruch der Zwölfjahr-Molaren. (Roentgen studies of the teeth in children. II. The normal set of teeth in children from the eruption of the six-year molars to the eruption of the twelve-year molars.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41* 49–53.

This constitutes a continuation of an article reported previously. As in the first article the examination was carried out by roentgenograms of the front teeth and of the lower jaws.

After describing in detail the roentgen appearence of the teeth (at yearly intervals) between six and twelve years, the authors arrive at the conclusion that at the age of twelve the lower (and probably the upper) incisors and the six-year molars have reached a stage of complete development. The canine teeth, the premolars, the twelve-year molars (and probably the upper incisors) still show the presence of foramina apicalia. The germs of the lower wisdom teeth lie obliquely in their sacs, at the margin of the horizontal and ascending rami of the jaw.—*T. Leucutia.*

NECK AND CHEST

Pottenger, F. M. The early diagnosis of tuberculosis. *Am. Rev. Tuberc.*, Feb., 1930, *21*, 159–182.

The author does not believe that we are making diagnoses as early as we should. Our methods are not keeping pace with our knowledge of the disease.

The varying aspects of tuberculosis. Contrary to the teaching of the past, clinical tuberculosis may make its first appearance in any part of the lung, the apex, the base, or anywhere between. The primary focus may be caused by few or many bacilli, the host may have a varying degree of natural resistance, and the primary focus may result in a low or a marked immunity. We have at one end of the series of cases of early clinical tuberculosis, infections of such a nature that the disease develops slowly and is accompanied by symptoms which are so mild, and have signs which are so insignificant, that they are recognized with difficulty, if at all. On the other hand, we have infections that cause rapidly developing disease with marked symptoms and signs. The symptoms and signs which make it possible to recognize clinical tuberculosis represent departures from the normal in the domain of both anatomy and physiology and the underlying cause of variation is the difference in immunological response brought about by the entrance, growth, dosage, and virulence of the tubercle bacilli in the tissues of various individuals.

Allergy, the basis of diagnosis. Allergic reaction is the immediate and principal response of previously infected organisms to all subsequent bacillary inoculations, and it is maintained by the host as long as the body cells remain specifically sensitized to tuberculosis protein. It is this allergic reaction which is responsible for the changes in pathology and symptomatology, the connection and course of the disease process, and the healing or death of the patient. Some patients are infected and healed without the patient being aware of the process. The patient does not become sick unless the numbers of bacilli causing the primary inoculation are sufficiently large not only to produce histological evidence but to produce and liberate the amount of tuberculosis protein into the body fluid that is necessary to call forth an adequate degree of tissue response. The reason why illness promptly follows reinfection when it tardily follows primary infection is known to depend on the fact that the body cells of individuals who have been infected previously possess a new power, namely, that of meeting bacilli or bacillary protein with an inflammatory response.

Early manifestations of tuberculosis. If the implantation of small numbers of bacilli were repeated sufficiently often, quantities of tuberculosis protein sufficiently large to stimulate the immunity mechanism would set free and cause an allergic reaction sufficiently marked at least to increase fibrosis about the original

focus which might result in healing where it had previously failed. This might occur without producing recognizable symptoms. If the number of bacilli implanted in new tissue were greater but still comparatively few, and the immunity of the host at the time was at a low ebb, the spread of the disease might take place before the immunity mechanism could be raised to a point necessary to successfully combat it. If, however, immunity was already established, an allergic response might follow sufficient to cause a varying degree of exudation and local injury to the cells. In the former condition widespread disease might develop without marked physiological disturbance. In the latter there would be a quick response and almost immediate symptoms. By understanding that tuberculosis makes its presence known by setting the immunity mechanism of the host into action and that the allergic inflammatory reaction is its most evident expression, it devolves upon physicians to familiarize themselves with this reaction so that it may be recognized.

The entire organism is subject to the reaction of the allergic response in three ways: (1) through the toxins; (2) reflexly; (3) locally in the tissues subject to the inflammatory process.

Toxins disturb the general physiological balance. Reflexly, the implanted pulmonary tissues disturb the physiological balance. Locally the allergic reaction may cause an increased permeability or a rupture of the walls of delicate capillaries which may result in hemoptysis, an increased secretion of the bronchial glands, an exudate into the air spaces, or a limited caseation followed by destruction of tissue with appearance of bacilli in the sputum.

Examination of the patient for early clinical tuberculosis. The author divides the symptoms occurring from each one of these allergic manifestations into certain groups and discusses them fully. The toxic symptoms may appear and disappear quickly. They may be severe and of short duration, or may be continuous over long periods of time. The reflex group remain as long as the inflammation exists in the lung.

Physical examination. Under this heading the author discusses at length inspection, palpation, percussion, and auscultation, calling attention to the importance of recognizing slight changes in the spasm of muscles, atrophy of skin, etc. He reviews the physiology that will cause the various changes. The roentgen changes are discussed briefly. He states it stands to reason that the mild reaction may be wholly missed by the roentgenogram while the severe reaction casts definite shadows. He goes into the matter of why various types of lesion absorb the rays and cast a shadow on the roentgenogram, and what changes in the lung constitute activity. The atomic weights of the different elements in the lung are given. The author states that an exudative or parenchymatous lesion should always be interpreted as being active, but it would be unwise to interpret the absence of such a lesion as positively meaning the absence of active disease.

Examination of the sputum and discussion of the tuberculin test receive some attention. The tuberculin test is the test for general cellular hypersensitiveness, the presence of tuberculoallergy, as this affects the body cells, both surrounding and at a distance from the foci of disease. The presence of cell hypersensitiveness to tuberculin means the presence of an infection with Koch's bacillus at the time or at some time in the past. The test does not give one any idea about the activity of the process.—*E. P. Pendergrass.*

Douglas, Bruce H., and Pinner, Max. Acute subapical versus insidious apical tuberculosis. *Am. Rev. Tuberc.*, March, 1930, *21*, 305–326.

Pathogenesis and clinical significance. Attention has been called to certain forms of tuberculosis in the German and French literature during the past few years but very little mention of these forms has been made in American or English literature. The onset of clinically demonstrable tuberculosis is frequently associated with suddenly appearing grippe-like symptoms and this symptomatology is apparently caused by a quickly developing infiltrating (bronchopneumonias) lesion whose localization is most frequently in the infraclavicular region.

Definition. The authors have divided pulmonary tuberculosis into acute subapical and insidious apical types. It is their belief that diagnostically, symptomalogically, prognostically, and therapeutically, "acute subapical," and "insidious apical" tuberculosis are so significantly different that for the matter of

quick understanding their terminological differentiation is highly desirable. When they speak of clinical types of tuberculosis they have endeavored to differentiate the disease very much as Osler would in speaking of abortive, grave, and ambulatory forms of typhoid fever. They feel that the present terminology is entirely unsatisfactory.

Relation of acute subapical foci to primary foci. Designating "acute subapical" foci as a frequent incipient stage of clinical pulmonary tuberculosis does not involve any judgment about the time of primary infection. In many patients with such acute lesions the roentgenograms bear witness that at some unknown time the patient acquired his usual primary infection. An intrathoracic primary complex is frequently present without producing roentgen evidence. Whether the acute pulmonary infiltrations may occur in virgin soil or whether they require an allergic territory for the development is open to speculation. It is probably safe to assume that infiltrative lesions in question are as a rule foci of reinfection and not primary lesions since it has never been reported that they show the picture and course characteristic for primary lesions, namely, healing by calcification and ossification and simultaneous involvement of the regional lymph nodes.

Relation of "acute subapical" foci to apical foci. The apical fields may be the seat of traditional nodular lesions and scars, or excavated acute infiltrations, of old isolated cavities and of primary foci. Every apical lesion should be judged on its own merits. The authors are concerned in this discussion with apparently healed nodular foci and scars in the apices only, which do not give rise to definite symptoms beyond those of phthisis phobia. For such lesions frequently described as minimal tuberculosis or even as "incipient tuberculosis" they claim that they are not the forerunners of progressive pulmonary tuberculosis in an incipient stage of this disease, and that the diagnosis and treatment of such cases will not prevent progressive lesions. They must be considered as obsolete foci whose active stages pass unnoticed. All clinical evidence points to the assumption that most apical foci develop without clinical symptoms or with symptoms of very slight degree and insidious nature. Pathological and roentgen evidence suggests that they are usually acquired in late childhood or adolescence. Their actual pathogenesis, endogenous, hematogenous, metastasis from the primary lesion, or exogenous, erogenous superinfection,—is still the subject for theoretical debate. According to Aschoff more than 90 per cent of all adults show, at autopsy, not only a primary complex but evidence of re-infections as well, the vast majority of these re-infection foci being found in the apical fields. It is the task of the clinician and roentgenologist to recognize the incipiency of manifest disease, but it is evidently impossible to treat prophylactically upward of 90 per cent of all adults because of their having apical scars, demonstrable or not. Many so-called prophylactic measures are but wasted efforts, because they are motivated by the unattainable aim to diagnose the disease before it really exists. To build up general health and promote better living conditions, are good preventive medicines, but to tell the person that he is threatened by pulmonary tuberculosis and to treat him prophylactically means that the actual disease has not been recognized or it is a statement unsupported by facts and knowledge. The authors' concept, therefore, is that apical scars cannot be considered as the inception or forerunner of progressive pulmonary tuberculosis any more than the primary foci; the true clinical incipiency of manifest disease is very frequently marked by the sudden appearance of infiltrative foci.

Pathogenesis and pathology of "acute subapical" infiltrations. Theoretically the acute infiltrations may be produced by exogenous inhalation infection, by hematogenous spread from the primary focus or from re-infection foci (apical scars) if present, or by bronchogenic spread from apical foci. Aschoff's studies in accordance with Huebschmann's indicate that each focus of re-infection starts with an exudative phase, regardless of localization and size of re-infecting dose; all re-infection foci are pathogenetically applied, in that all start as Frühl-infiltrate. It is of great practical importance to distinguish between traditional teaching and the new knowledge. According to traditional teaching, insidious onset with chronic, insidious symptomatology and slow, gradual progress represents lesions whose incipient stage required all of the skill of clinicians and roentgenologists to discover; according to the "new teaching" there is a sudden onset with mostly

marked, though frequently misinterpreted, symptoms, a progress characterized by acute exacerbations and periods of chronic intermission, and with initial lesions whose roentgenographic demonstration, at least, is no problem requiring specially refined technique.

Clinical significance of "acute subapical" foci. The authors stress the point that they have never seen a single series of films showing the slow apiocaudal progress of strictly apical foci without the intervention of acute infiltrations. However, they have seen cases whose first demonstrable lesions consisted of multiple small and apparently exudative foci scattered more or less regularly throughout one or both pulmonic fields. Such lesions are probably pathogenetically developed from the isolated acute infiltration; they suggest strongly hematogenous origin; they show less tendency to extensive caseation; if they heal, calcification plays a more important rôle in them than in other lesions in adults, but the pathology of the individual early lesion is probably not different from that of a more massive isolated acute infiltration.

Diagnosis of acute infiltrations and of apical lesions. In spite of the amount of work that has been done on the early diagnosis of pulmonary tuberculosis it is still true that the vast amount of persons found to have the disease are suffering from it in an advanced form. This is due to the fact that the patient looks upon himself as a sufferer from just a cold or possibly influenza so that when the symptoms are sufficiently severe to cause him to seek medical advice the disease has become very advanced. In order then to recognize the disease in its incipiency it is wise to consider every undue protracted cold, or every attack of influenza as a possible acute onset of pulmonary tuberculosis. The physical findings are discussed at length and there is also discussed thoroughly the diagnostic aid of the laboratory from sputum examinations and blood counts. Cough and expectoration are explained. The finding of tubercle bacilli in the sputum is of diagnostic value. Blood counts are only of value on the day they are taken. A relatively high white count, a slight leucocytosis, and a slight shifting to the left indicate a still unstable and probably progressive lesion. Return to normal or a lymphocytosis is usually associated with a lesion which is stationary or undergoing a fibrosis.

The extent of the lesion, its pathologico-anatomical nature, the absence or presence of cavities, and local and general signs and symptoms of activity constitute traditionally the essential data for a complete diagnosis of pulmonary tuberculosis. The time factor is of high practical importance, particularly in regard to prognosis and therapeutic indication. Thus two lesions presenting the same appearance in all diagnostic respects are distinctly different in their potential developments if one has existed twice as long as the other.

Further developments of acute infiltrations. Under this heading the authors discuss and give excellent examples illustrating; (1) resorption; (2) fibrosis; (3) caseation and excavation.

1. This excellent paper is summarized in stating that it is justifiable to attempt to differentiate infiltrative *subapical* and nodular *apical* tuberculosis.

2. Clinical and roentgenologic character of the infiltrative subapical tuberculosis does not explain the nature of its beginning or of its relation to the primary infection of the individual.

3. The evidence strongly points to the conclusion that nodular apical tuberculosis is not an incipient lesion but is a more or less benign process of long standing but with little or no tendency to progress.

4. The infiltrative subapical lesion, however, is usually of quite recent origin and is potentially more grave from the standpoint of progression.

5. The chronic apical lesion tends to be a nodular, productive one, whereas the subapical tends to be an infiltrative one and is probably an acute exudative lesion.

6. Every effort should be directed toward the early recognition of the acute subapical type; the diagnosis resting upon: (*a*) the history of an acute onset or exposure; (*b*) presence or absence of physical findings in the lung; (*c*) roentgenogram of the lung; (*d*) painstaking examination of the sputum.—*E. P. Pendergrass.*

Fenger, E., Mattill, P. M., and Phelan, E. Tuberculous infection in school children. *Am. Rev. Tuberc.*, Feb., 1930, *21*, 183–194.

The authors have studied the incidence of tuberculous infection in children attending city

dispensaries and hospitals where they are receiving treatment for some known tuberculous infection. In this article the authors review the findings of many authors who have been interested in this problem. Their studies included the roentgen examination and the tuberculin reaction in addition to the clinical studies. Their conclusions are as follows:

1. The incidence of tuberculous infection in school children in the rural Hennepin County, Minn., is much lower than that usually reported.

2. The "questionable positive" group may report an infection that is of such low grade that it gives no appreciable reaction or it may represent a once active infection that is dying out.

3. The markedly positive group represents those cases having received recent or repeated infections.

An effort should be made to find the source of infection wherever it is not known. These children should be given special attention so that they will not develop manifest tuberculosis as they pass through childhood to adolescent maturity.

4. The high incidence of tuberculous infection in the contact cases is again shown.

5. Nutrition does not seem to be predisposed to infection nor does it necessarily follow after infection has taken place.

6. Roentgenograms are essential in determining pulmonary involvement in infected cases. There is a complete correlation between the positive reactors and the findings on the roentgenograms. Nevertheless, the authors feel that the roentgenograms give much valuable information and that films should be taken on at least all of the positive reactors.—*E. P. Pendergrass.*

Ochsner, Alton. Bronchiectasis. *Am. J. M. Sc.*, March, 1930, *179*, 388–405.

The author states that bronchiectasis is the most frequently encountered chronic pulmonary condition in his personal experience, and he states that because of the persistent cough which resists all forms of therapy it is often treated as tuberculosis, in spite of reported negative sputum. Bronchiectasis may be caused by tuberculosis but it is rare.

The etiology of bronchiectasis is varied. Some believe it to be due to congenital cystic changes in the lung; others believe that cirrhosis of the lung may play an etiologic rôle. Chronic pneumonia has been mentioned as a cause. Acute infectious diseases and chronic sinusitis may cause bronchiectasis. Bronchiectasis has been attributed to a loss of nerve control of the bronchi; to obstruction of bronchus by stenosis; to congenital narrowing; to inspired foreign bodies or to neoplasm. Of the varied causes chronic bronchitis is the most important.

In a discussion of the pathological anatomy three types of bronchial dilatation are described: (1) cylindrical; (2) fusiform, and (3) saccular. The latter type has been described as the congenital type. Dilatation may occur in the bronchi, bronchioles or both. In the early stage there is a hypertrophy of the mucosa of the bronchi and bronchioles as well as hypertrophy of the peribronchial obstruction. There is a catarrhal swelling of the mucous membrane. Desquamation of epithelium may result in hemorrhage and there may be calcification of degenerated portions especially in the region of the cartilage. In advanced stages an atrophic form is described where entire bronchial wall is replaced by fibrous tissue, and the tissue surrounding the bronchi shows fibrosis and atelectasis. The author states that bronchial dilatation, in all probability, precedes any anatomic change, and that by far the greater number of cases of bronchial dilatation which are clinically improved by the introduction of iodized oil into the tracheobronchial tree have relatively little anatomical change in the bronchial wall. Bronchial dilatation may be due to atony of the musculature, secondary to bacterial toxins, aided by stagnation of retained secretions. The lower lobes are most frequently involved, the left more frequently than the right. The reason for the latter is unknown. The clinical picture described in textbooks is that of late stage. The signs of early bronchial dilatation or bronchiectasis are relatively insignificant with or without sputum. The diagnosis in each case was made bronchographically. The sputum, if present, is rarely fetid and posture may result in sputum in the so-called cases of dry bronchiectasis. The cilia are lost early in the disease. Hemoptysis is present in from 50 to 70 per cent but is often small in amount. Slight lassitude is present in some cases and

occasionally there are vague symptoms, resulting in the patient being classified as a neurotic. Bronchography has been a great aid in the diagnosis. In early cases the physical findings are minimal. There is slight lagging of the affected side with no change in percussion and only a few râles to auscultation. In advanced cases the clinical signs are well marked.

The introduction of iodized oil into the tracheobronchial tree in conjunction with roentgen studies has facilitated an early diagnosis of bronchial dilatation or bronchiectasis. The only symptom present in many of the author's cases was cough. Fluoroscopic study of the introduction of the oil is important because these dilated bronchi may be obscured by the filling of superimposed bronchi.

In the medical treatment the results are more or less unsatisfactory. The surgical treatment is varied. At the present time surgical collapse is most widely practised but it is not to be considered a curative measure. The form of collapse used may be either artificial pneumothorax or thoracoplasty. Evulsion or division of the phrenic nerve on the affected side has given good results. Lobectomy has not been very successful, because of the high mortality.

At this present time the medical treatment consists chiefly of postural drainage, intratracheal injections and in some continental clinics dehydration. Vaccine therapy has shown no results. The author has found intratracheal injections of iodized oil to have beneficial effects in bronchiectasis. He has found a decrease in the number or organisms in the sputum following these injections and a parallel clinical improvement of the patient. Experiments performed in vitro show iodized oil to be not bactericidal, but this cannot be compared with those obtained clinically. The author states that there are no untoward effects from intratracheal injection of iodized oil. A few cases may show iodism which lasts only forty-eight hours. No pathological changes have been demonstrated as a result of this procedure. Iodized oil should be used cautiously in pulmonary tuberculosis.

The author obtained a symptomatic cure in 32 per cent of all his cases, and caused the bronchial dilatation to disappear in 4 cases. He states that in all cases there no doubt was only a fractional dilatation of the bronchi. In 96 per cent of the author's cases there was a return of symptoms following a second upper respiratory infection, which were not as severe as before treatment and responded quickly to additional treatment. In the remaining 32 per cent there was marked improvement. The ultimate result of this treatment is not as yet known but the high percentage of improvement shown in this author's series of cases makes this mode of treatment satisfactory if the iodized oil can be introduced without discomfort to the patient and the author describes his "passive technic" for accomplishing this.—*E. P. Pendergrass.*

Held, A. Die Hodgkinsche Krankheit der Lungen. (Hodgkin's disease of the lungs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, *41*, 191–206.

Thirteen cases of Hodgkin's disease with involvement of the lungs are briefly described and their roentgenograms presented.

On the basis of the roentgen appearance, the author distinguishes the following four groups: (*a*) simple mediastinal lymph node tumors; (*b*) mediastinal tumors with direct extension to the lungs; (*c*) distinct lung processes in addition to the mediastinal tumor, and (*d*) disseminated forms. This classification is somewhat arbitrary for transitional forms of all types may occur.

Differential diagnosis includes the true mediastinal and pulmonary tumors, the malignant metastases to the lungs and tuberculous processes.

The conclusion is reached that the intrathoracic manifestation of Hodgkin's disease shows no characteristic roentgen appearance. Since the condition is merely a local manifestation of a generalized systemic disease, various forms of invasion may be encountered. The question is further complicated by the fact that the applicaton of roentgen therapy may entirely change the picture and produce an entirely different roentgen aspect of the disease.—*T. Leucutia.*

Miller, James A., and Jones, Oswald R. Primary carcinoma of the lung. *Am. Rev. Tuberc.*, Jan., 1930, *21*, 1–56.

This is a presentation of the clinical aspects of primary carcinoma of the lung, which may more properly be designated as primary bronchial carcinoma. The literature on the subject

is reviewed from 1911 up to the present time and 32 definitely substantiated cases, never before recorded, are presented.

The history of pulmonary cancer shows that it was almost an unknown entity until the 19th century, when it was recognized with the development of studies in pathological anatomy. Bayle, in 1810, seems to have been the first one to actually recognize pulmonary cancer as such. Stokes, in 1837, was the first to use percussion and ausculation for the direct demonstration of pulmonary cancer during life. He gave such a full description of the clinical diagnosis of this disease that the writers following him for some years had very little to add to it. In 1853 Virchow published his masterful studies of pulmonary tumors, which are the basis of our modern conception of this pathological condition. In 1911 Adler made an exhaustive survey of this disease in his classical publication on this subject, and since that time a great many authors have discussed different phases of primary pulmonary neoplasm.

As to the incidence of this disease, Carman states it to be his belief that cancer of the lung represents 1 per cent of all cancer and 2 per cent of deaths from all forms of pulmonary disease. Statistics do not bear out the belief that the disease is on the increase. In relation to sex, the condition is found more frequently in men than in women, in the proportion of 3 to 1, while the average age incidence, according to Hauf, is fifty to fifty-four. McCrae et al., state that 91 per cent of all cases are past thirty-five years of age.

Many theories have been advanced to account for the origin of pulmonary cancer, but little is actually known. Most authors agree in laying emphasis upon chronic irritation of the bronchial mucosa as one of the underlying causes. Among the etiological factors advanced by various authors are overgrowth of a fetal bronchiectasis, atelectatic pulmonary tissue, tuberculosis, influenza and irritation from dust.

Pathologically the disease is divided into three main groups:

1. Carcinoma of the lining epithelium of the bronchi.

2. Carcinoma of the mucous glands of the bronchi.

3. Carcinoma arising from the pulmonary alveoli.

In addition to the primary lesion the condition is often complicated by secondary lung changes such as atelectasis, bronchiectasis, necrosis and pleural thickening. Inflammatory changes, such as an exudative pneumonia, or an interstitial pneumonitis and a secondary pleural effusion, either serous, bloody, or purulent, is frequent. Abscess formation and necrosis of the growth are common occurrences.

Metastasis in 808 cases collected from the literature occurred most frequently in the pleura, the liver, regional and remote lymph nodes, other parts of the lungs and the kidneys, in the order given. From the clinical point of view, emphasis should be placed upon the frequency of metastasis to the bone and the brain.

Under the heading of clinical manifestations is given an analysis of the symptoms occurring in primary carcinoma of the lung. Cough is the most frequent symptom, the sputum is not characteristic; hemoptysis is a very frequent and important symptom occurring in more than 50 per cent of the cases. Dyspnea is present in about half the cases and probably starts early in the disease. Pain is a very uniform accompaniment and next to the cough is regarded by most authors as the most common symptom. Secondary metastases to the lung seldom cause pain. Cyanosis, stridor, hoarseness and dysphagia are symptoms usually arising from involvement of the mediastinal lymph nodes late in the disease.

Of the systemic manifestations fever is the most common. It is important from a diagnostic point of view frequently leading to a diagnosis of inflammatory rather than a neoplastic disease. Loss of weight, weakness and cachexia are late symptoms. Osteoarthritic changes may occur.

In the symptoms due to metastasis pain is of prime importance. Other symptoms are dependent upon the localization of the metastasis.

The physical signs of pulmonary carcinoma are varied and not pathognomonic. The diagnosis must often be made in the absence of physical signs.

The evidence offered by a roentgen examination of the chest is the most valuable single means of determining the presence and location of a pulmonary tumor. The character-

istic appearances, however, are often marked by secondary changes, making differential diagnosis difficult. Not alone in diagnosis but in prognosis serial roentgenography is of extreme value.

If sectioning of the tissue which may be obtained directly from the tumor or from a metastatic deposit be excluded, the laboratory aids comparatively little in the diagnosis of this disease.

In all cases of chronic pulmonary disease in which the diagnosis is obscure, examination by means of the bronchoscope is becoming more and more an important factor. The authors believe that the diagnosis of early bronchial carcinoma can only be positively established by this method.

The authors have endeavored to simplify the confused picture of primary bronchial carcinoma by classifying the cases usually encountered into ten clinical types distinguished by their pathology, symptomatology, physical signs, roentgen and bronchoscopic findings.

Type 1. This tumor is intrabronchial, arises entirely from the wall of the bronchus, and is manifested early by cough and blood spitting. Physical signs usually absent. Roentgen examination is negative. Diagnosis is made by bronchoscopic examination. The recognition of this early type of disease is extremely important, as it is one of the few at the present time amenable to successful treatment, which is by bronchoscopic removal.

Type 2. The peribronchial form of lesion, later than Type 1, in which there is infiltration commencing in the lining membrane of the bronchus and extending into the parenchyma of the lung. Roentgen picture fairly typical, showing the densities along the roots of the lung with radiations out into the parenchyma. The diagnosis can often be confirmed by bronchoscopic examination.

Type 3. The solitary nodule tumor, in which the lesion consists of a rounded, sharply outlined tumor mass located far out in the lung field in the roentgenogram or close to, and connected with the hilus by a thin band of infiltrated tissue. The origin may be bronchial or alveolar. This type is quite rare and is usually benign rather than malignant.

Type 4. The scirrhous type of the disease, occasionally seen. This lesion may result from bronchial obstruction by infiltration of the growth causing collapse of a lobe with subsequent fibrosis, or it may be due to an infiltrating tumor which does not obstruct the bronchus, but causes the production of fibrous tissue reaction with resulting shrinkage of the lobe involved. This lesion is usually an epithelioma arising either from the metaplasia of the bronchial epithelium, or sometimes from an old tuberculous process. Symptoms are more marked, generally pain and dyspnea and frequently fever. Physical signs show retraction and diminished expansion of involved portion of chest. Marked dullness, tubular breathing or absence of breath sounds. The roentgenogram shows a dense shadow with a concave lower border that has a sharp line of demarcation. Slow growth, metastasizes slowly, may be mistaken for tuberculosis. It is the type which might be considered possibly curable by means of radical surgery.

Type 5. The mediastinal phase of the lesion, more advanced but of the same nature as Type 2. The physical signs are usually found in the interscapular region and consist of slight dullness with diminished breath and voice sounds and occasionally a few râles. The roentgen picture is very definite, showing a rounded, dense shadow extending out from the hilus.

Type 6. The massive consolidation stage in which the tumor densely infiltrates the entire lobe or a large portion of one lobe. Pleura frequently involved. Pain is an associated symptom. Physical signs similar to those of Type 5. The roentgenogram shows a lesion usually in the upper lobes, invariably limited by the interlobar septa, giving a shadow of a density which rarely obscures the ribs and diminishes in density toward the apex and the periphery. The diaphragm is usually high.

Type 7. In this phase there is massive consolidation with abscess formation. Among the symptoms are a very profuse, often foul, expectoration, and almost always septic fever. The physical findings and roentgen appearances are those of pulmonary abscess.

Type 8. This is the bronchial obstruction stage in which the stem bronchus leading to the lung or one of its lobes is obstructed. Before this becomes complete many pathological changes may occur, such as bronchiectasis, thickening of the pleura, pleural effusion and necrosis of the lung parenchyma. With com-

plete obstruction, massive atelectasis occurs. The symptoms and physical signs are those characteristic for the various changes enumerated, eventually terminating in those of atelectasis. By frequent roentgen examination the development from partial to complete bronchial obstruction is readily followed.

Type 9. A curious and rather unusual type in which the tumor is disseminated along the course of the main bronchus in the form of patchy areas of infiltration with small, rather discrete nodules. Physical signs are those of bronchopneumonia of a portion of the lung. The roentgenogram shows numerous small patchy areas of density along the main stem bronchus. The diagnosis is difficult. It is usually made by watching the disease develop. The bronchoscope is less apt to help in the diagnosis, as the lesions are frequently too far down the bronchial tree.

Type 10. That of miliary carcinosis in which there are small miliary areas of carcinoma distributed throughout both lungs. The literature reveals only a few authentic cases. Physical signs are those of a diffuse bronchitis or a patchy basal pneumonia. X-ray very closely resembles confluent miliary tuberculosis or if the areas are large, some cases of bronchopneumonia.

The progress of modern surgery is beginning to make the early diagnosis of bronchial carcinoma a matter of serious importance to the life of the patient. In Types 1 and 3 and possibly in Types 2 and 4, an early diagnosis might lead to possible radical cure by surgery. Type 1 can be removed through the bronchoscope

The differential diagnosis of the various types of lesion is given. Primary bronchial carcinoma may at times simulate any form of pulmonary disease. Tuberculosis is the most frequent. Roentgen and bronchoscopic examinations offer the best means of establishing the diagnosis.

Among the types described in Types 1, 2, 3 and 4 metastasis is relatively slow and inasmuch as these types are the ones for which, theoretically, something might be done in the way of treatment, their early recognition becomes particularly important. In general, the prognosis of the disease is uniformly bad. Death usually occurs from three to fourteen months after the appearance of definite symptoms.

Under treatment the following methods are considered preventive: roentgen ray, bronchoscopic and radical surgery. Little can be done in the preventive treatment until more exact knowledge concerning etiology is at hand. Until then, all forms of lung irritation such as infection and dust inhalations must be guarded against. The main treatment at the present time is symptomatic.

Roentgen treatments, in the authors' experience, have not arrested the progress of the disease. It may at times relieve pain and prolong the patient's life. It is contraindicated where there is obstruction of the bronchus with atelectasis, as in these cases the symptoms are aggravated and predispose to necrosis and abscess formation.

In the very early cases, bronchoscopic removal of the lesion offers the best hope of ultimate cure. Bronchoscopic drainage may also be used palliatively in the more advanced cases. With the rapid strides being made in thoracic surgery, it may be expected that cures may result from this form of treatment if the cases are seen sufficiently early.

Summaries of the 32 proved cases are given. —*Karl Kornblum.*

Popović, Laza. Bemerkungen zum Pneumothorax. II. (Remarks on pneumothorax. II.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 57–61.

The author performed a series of experiments in rabbits and dogs in order to determine the mechanism of the intrathoracic injection of air in pneumothorax. The following four stages were distinguished: (1) the formation of air bubble which was of a very short duration and which due to the resistance of the inflated lungs soon transformed into (2) an air disc; (3) total compression of the lung, and (4) total collapse of the lung.

The technique of the experiments was as follows: the animals were killed with chloroform or cyanide of potassium; a window was cut in the side of the thorax and a celluloid plate provided with a tight fitting injecting needle was inserted in the window. The lungs (which collapsed when opening the thorax) were then inflated and the mechanism of injection of the air actually observed. In some instances lipiodol was used in place of air.

It was attempted to carry out the experiments also in living animals but so far they have been unsuccessful.—*T. Leucutia.*

Tamiya, Chichio. Über ein neues Prinzip für Grössenbestimmung des Herzens und seine praktische Anwendung. (On a new principle for the determination of the size of the heart and its practical application.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 62–66.

The usual methods for the determination of the size of the heart consist (1) in teleroentgenography with films at 2 meter distance, and (2) in the well-known Groedel's method.

The author devised a new method which he calls orthophotography and which is based on the principle that a specially constructed tube emits roentgen rays in two opposite directions, one beam being used for the actual roentgenoscopy while the other registers the findings on a roentgen film mounted on the back of the tube box.

The tube, which is a "bicathode" tube, is constructed in such a manner that both endings serve as anodes and the cathode (which has two parallel surfaces and is suspended in the center of the tube by a mounting to the side of the tube), functions alternatingly as target for the electrons emitted from the two anodes. The one surface of the target directs the beam forward to the roentgenoscopic screen, while the other surface directs an identical and exactly parallel beam backward to the roentgen film. This permits the tracing of the borders of the heart on the screen (orthodiagraphy) and their simultaneous registration on the roentgen film (orthophotography).

In the above procedure the tube is run alternatingly for the two target surfaces. This is accomplished by means of a special connection of the valve tubes (the machine is valve rectified), half of the wave being directed to one anode, and the other half to the other anode. However, if so desired, the tube may be run continuously by a simple switching (rearrangement of the connection) of the valve tubes, with either of the two target surfaces, thus permitting the performance of roentgenoscopy, teleroentgenography, as well as all the usual roentgenographic examinations with the same apparatus.—*T. Leucutia.*

Sanders, Robert Lee. Diaphragmatic hernia. *Ann. Surg.*, March, 1930, *91*, 367–380.

Attention is called to the increasing frequency of the recognition of diaphragmatic hernia since the general use of roentgen examinations, many cases without symptoms being found accidentally. The congenital type may become manifest at any age, and when trauma is the cause, years may elapse between the injury and the onset of symptoms.

The congenital cases are caused by a failure of the component parts of the diaphragm to meet and unite. If it develops before the membranous diaphragm is complete there will be free communication between the thoracic and abdominal cavities. The hernia will be without a sac. If it develops after the diaphragm has formed there will be a sac composed of the opposed layers of pleura and peritoneum. In the first type there is less danger of strangulation, the organs acquiring a tolerance to their crowding and being freely movable. The second type may not develop until long after birth, the rapidity depending on the size of the defect and any unusual strain. Both types are more frequent on the left side. Enlargement of one of the natural permanent openings permits the formation of a slightly different type of congenital hernia. A congenital shortening of the esophagus or the failure of it to attain adult length on account of cicatrices resulting from swallowing corrosive substances in infancy or early childhood may cause a portion of the cardia to remain above the diaphragm.

Of the acquired types, the most frequent are the cases due to gunshot, shell or stab wounds of the diaphragm. Accidental slitting of the diaphragm during thoracic operations has been reported in several cases.

In both types of cases the migration of the abdominal viscera up through the aperture, against gravity and anatomic anchoring, is caused by the difference in pressure between the two cavities, a combined influence of pressure and suction with each breath.

The symptomatology, referable to the respiratory and circulatory systems on one hand, to the gastrointestinal system on the other, varies with the location of the hernia, with the organs involved and their condition. Symptoms may be absent or may vary with the fullness of the herniated viscera, the position of the patient and the size of the opening. Strangulation

may occur. Especial danger is present during pregnancy and labor. Four cases of the author are presented.—*P. A. Bishop.*

Overholt, Richard H. Diaphragmatic hernia. Phrenic nerve stimulation under fluoroscope as an aid in diagnosis. *Ann. Surg.*, March, 1930, *91*, 381–391.

This paper discusses the differential diagnosis between diaphragmatic eventration and hernia with some remarks about the technical procedure in the treatment of the latter condition.

In hernias where the protrusion through the diaphragm is a large one, the dome of the hernia may give the same roentgen appearance as that seen when the diaphragm itself has assumed an abnormally high position. To this latter condition the terms eventration, diaphragmatic insufficiency, elevation, relaxation, "hochstand," etc., are applied. It is explained as being due to a degenerative or congenitally defective musculature or a paralysis of the phrenic nerve. In eventration the viscera and the diaphragm are forced upward by the difference in thoracic and abdominal pressures in the same manner as in herniation. The thin line separating the pulmonary tissue from air collections in the stomach or colon in eventration is due to the thin diaphragmatic partition, while in hernias it is due to the sac or the visceral walls.

The two conditions are found to be repeatedly confused in the literature due to similarity of physical signs, symptoms and roentgen findings. Differentiation is important from the standpoint of treatment.

The following methods have been applied in making a differential diagnosis:

1. *Movements of the Costal Margins.* Normally the outward excursion of the costal margins is limited by the pull of the diaphragms. In cases of eventration this effect is limited or absent and a more noticeable excursion is permitted on the involved side. In some cases of hernia in which there has been a wide separation of diaphragmatic musculature this test is not reliable.

2. *Roentgenoscopic Signs.* In eventration the diaphragm produces a thin, smoothly curved shadow which is highly placed in the lower thorax. In hernia this line may be irregular. Some observers have called attention to the absence of lung markings behind the elevated diaphragm in cases of eventration. Paradoxical diaphragmatic movements may or may not be present in either condition. This also applies to shifts in the mediastinum during respiration. A barium meal usually presents valuable findings. Carman and Fineman have pointed out that in hernia the meal may assume a higher level than the cardiac orifice, while in eventration it will never go above that point. Repeated examinations often show in cases of hernia an altered picture, while in eventration the findings are uniform.

3. *Intragastric Pressure Studies.* In hernia cases, the pressure in that portion of the stomach which is in the chest varies in accordance with the pressure variations within the intrapleural sac. If the stomach is still in the abdomen, as in cases of eventration, the findings should be normal, i.e., the intragastric pressure curve rises with the descent of the diaphragm and falls with its ascent.

4. *Pneumoperitoneum.* This method has been used by Verbrycke and others.

5. *Laparotomy.* Operation has been thought to be justified in some cases to definitely establish a diagnosis.

6. *Faradization of the Phrenic Nerve.* By exciting the phrenic nerve on the affected side, a response of the diaphragm can be seen under the fluoroscope. In eventration this fails to cause a contraction.

A case is reported and illustrated in which a differential diagnosis was made by the use of this method, all others being inconclusive. The bibliography contains 39 references.—*P. A. Bishop.*

Gianturco, C. Un caso di paralisi del diaframma sinistro. (A case of paralysis of the left side of the diaphragm.) *Arch. di radiol.*, Sept.-Oct., 1929, *5*, 891–896.

A peasant twenty-seven years of age came for examination on account of epigastric pain which radiated to his left shoulder on eating. The pain began about six months before, about three months after he had recovered from a left pleurisy, and had increased since. He sometimes had retching but no vomiting; no melena, no icterus, no fever. He was pale and in a poor condition of nutrition. Roentgen examination showed a large shadow in the region of the left hilus

probably caused by enlarged glands, paralysis of the diaphragm on that side, the left half of the diaphragm rising 6 to 7 cm. higher than the right and showing paradoxical movement, displacement of the heart to the right and cascade stomach with exceptionally rapid emptying time. The paralysis of the diaphragm was probably caused by the phrenic nerve being caught in the enlarged glands at the hilus.

This was probably an eventration of the diaphragm due to paralysis of the phrenic nerve, though it showed the paradoxical movement supposed to be characteristic of hernia as well as the double line of the arch seen in eventration. There was also variability of the organs contained in the arch but the author thinks this may occur in eventration as well as in hernia, particularly as adhesions are apt to occur at the hernial opening. Cascade stomach is frequent both in eventration and hernia of the diaphragm and is attributed to rotation of the stomach around the cardia because of the aspirating action of the thorax, and to the upward and backward push of the colon on the anterior surface of the organ. Both these factors were probably active in this case as the stomach appeared to be rotated on its axis and astride the colon. The rapid emptying may have been caused by pressure similar to that exercised on the phrenic by the enlarged glands, or it may have been due to the changed form of the organ affecting the function of the pylorus.—*Audrey G. Morgan.*

Jenkinson, E. L. Diverticula of the esophagus. *Radiology*, May, 1930, *14*, 508–512.

Diverticula of the esophagus are classified by the author as (1) pulsion, (2) traction and (3) traction-pulsion. The pulsion type may be congenital, be present at an early age, or may develop during late adult life. Symptoms are usually present, and depend upon the amount of food retained in the sac, leading to dilatation of the sac, and pressure. These diverticula are most common at the junction of the pharynx and esophagus. If they are in the lower third of the esophagus, the sac is usually small and points down. They probably occur through a weak spot in the esophagus, possibly where a blood vessel passes through the muscle. Traction type diverticula are most common in the middle third of the esophagus, following some inflammatory process in the lungs, pleura, or mediastinum. The adhesions which follow pull the esophagus outward. The sacs are usually small and the apices point upward. They usually cause no symptoms, unless they harbor food and become dilated. They develop into the traction-pulsion type and become large, due to pressure. Multiple diverticula of the esophagus are not common, but do occur. The cases the author has seen have been located in the middle third, and range in size from 5 mm. to 3 cm. They usually cause symptoms and he believes are of the pulsion type.—*J. D. Camp.*

ABDOMEN

Podesta, V. Il quadro radiologico del tubo digerente in un caso di dispepsia nervosa con pneumatosi gastrica e meteorismo cronico del tenue e del crasso intestino. (The roentgen picture of the digestive tract in a case of nervous dyspepsia with pneumatosis of the stomach and chronic meteorism of the small and large intestine.) *Arch. di radiol.*, Sept.-Oct., 1929, *5*, 873–890.

A case is described in a woman of thirty-nine whose first child was born when she was thirty-two years of age. During the pregnancy and for about six months after the puerperium she had digestive disturbances consisting of diffuse pain in the abdomen, particularly the epigastrium, eructation and flatulence, nausea, occasionally vomiting and diarrhea; at times bulimia and acoria, generally stubborn constipation. She recovered after she stopped nursing the child but during the second pregnancy the symptoms returned and in addition she had insomnia and marked loss of weight. She was treated at various sanatoria and improved a great deal. But after the death of her husband the symptoms recurred and she had not been free of them since. She was treated at various hospitals and in one of them an appendectomy was performed.

She was sent to the author in October, 1928, for roentgen examination. Wassermann negative. She was very much depressed; the walls of the abdomen were flabby, there was meteorism, no localized pain points. The patient said she had so much digestive disturbance after eating that she ate little but eggs and milk. She complained of dryness of her mouth and throat, eructation, pyrosis, flatulence and intermittent abdominal cramps.

Roentgen examination showed scoliosis of the spinal column but no lesions of the bodies of the vertebrae. There was marked meteorism of both the small and large intestine and a large amount of gas in the stomach. Gall-bladder normal. The stomach on different examinations showed different forms: hour-glass shape, snail-shape, cascade stomach, etc. Emptying time of the stomach and of the small intestine normal. As the author could find no reason for her symptoms, he sent her to a neuropathologist under whose treatment she improved greatly; she gained 14 kilograms in weight and another roentgen examination showed no meteorism and no deformity of the stomach.

He weighs the evidence in the case and concludes that the disturbance was purely nervous. It came on the first two times during pregnancy and the third after the death of her husband. He thinks the meteorism of the intestines could not have caused the various deformities of the stomach. They may have been caused partly by contracture of the stomach, and Assmann says that when there is irritability of the gastric mucosa the pressure exercised by a distended colon may cause active tetanic contraction of the walls of the stomach.—*Audrey G. Morgan.*

Morton, Charles B. Hypertonicity in hypertrophy of the pylorus in adults. *Arch. Surg.*, March, 1930, *20*, 508–514.

Attention is called to this syndrome with the belief that it constitutes a definite clinical entity. The author reports 3 personal cases in detail. The literature on the subject is scant but the condition has been recognized as one causing definite gastric symptoms, has been found at operation unassociated with other gastric lesions and has been relieved by repair or gastroenterostomy.

The cause is not known. It seems probable that abnormal nerve stimuli or abnormal response to normal stimuli may cause pylorospasm and that long-continued spasm may cause hypertrophy. The symptoms resemble those of peptic ulcer. Epigastric distress and fullness rather than actual pain, nausea and periodic vomiting are prominent findings.

The final diagnosis must be made roentgenologically. Constant spasm of the pylorus with more or less lengthening and narrowing of the lumen of the pylorus is presumptive evidence and when accompanied by signs of gastric stasis or retention is conclusive evidence of pyloric stenosis. The stasis is not a constant feature however. It is probable that many such cases have been diagnosed "pylorospasm" and dismissed as neurasthenic cases.

Surgical treatment is indicated in all but the mild cases. Plastic repair and gastroenterostomy have brought permanent relief.—*P. A. Bishop.*

Steinbach, M. Maxim. Comparative radiographic and anatomical studies of intestinal tuberculosis. *Am. Rev. Tuberc.*, Jan., 1930, *21*, 77–101.

A study is made in which the roentgen findings in the gastrointestinal tract of 67 cases of far-advanced pulmonary tuberculosis are compared with the findings at necropsy.

A review of the literature relative to the roentgenologic diagnosis of intestinal tuberculosis is given starting with the work of Stierlin, reported in 1911. The classical Stierlin sign of cecal tuberculosis is the failure to visualize the cecum and ascending colon, whereas the terminal ileum and the transverse colon are filled, the opaque medium having been given by mouth. Subsequent investigators found that Stierlin's sign was not pathognomonic for tuberculosis.

The work of Brown and Sampson in this country has given a strong impetus to the use of roentgenography in the diagnosis of intestinal tuberculosis. In 2,595 patients that were studied roentgenologically at Trudeau for the presence or absence of intestinal disease, the diagnoses in 85 were verified by surgical exploration and in 21 by autopsy, while in only 2 was there a disagreement between roentgen and pathological findings. This stimulating work prompted the authors of the present paper to adopt the roentgenogram in the diagnosis of intestinal tuberculosis

Sixty-seven cases studied roentgenologically came to autopsy. These cases were grouped as follows:

Group 1. Cases in which the roentgen findings coincided with autopsy findings (32).

(1) Positive roentgenologically and at autopsy (20).

(2) Suspicious roentgenologically for positive findings and at autopsy positive (5).

(3) Roentgenologically negative and at autopsy negative (7).

Group 2. Cases in which the roentgenologicla findings were at variance with autopsy findings (35).

(1) Roentgen picture of intestinal tuberculosis but negative at necropsy for tuberculosis (3).

(2) Roentgen picture normal—at necropsy positive findings of intestinal tuberculosis (18).

(3) Roentgen findings indefinite—positive at necropsy (6).

(4) Roentgen findings indefinite—negative at necropsy (4).

(5) Roentgen findings indicated tuberculous colitis but autopsy revealed the lesions to be located solely in the small intestine (4).

It is seen from this study that the roentgen signs usually considered diagnostic of intestinal tuberculosis were unreliable in over 52 per cent of the cases.

Various writers are quoted to show that the incidence of intestinal tuberculosis in association with fatal pulmonary tuberculosis is rather high, ranging from 56.6 per cent (Fenwick and Dodwell) to 92.6 per cent (Englesmann). In spite of this high incidence it appears to be the general experience of clinicians that in 50 to 75 per cent of cases the diagnosis of intestinal involvement is missed in pulmonary tuberculosis.

The point is emphasized that pathological examination of the intestine should in all cases be microscopical as well as gross. Examination of the intestine without incising the gut is not to be relied upon, since many of the early ulcerations involve only the mucosa and submucosa. It must be obvious, therefore, that surgical inspection of the intestine in vivo will fail to visualize a considerable number of tuberculous ulcerations.

From their experience with the roentgen examination the statement made by the authors that "in view of the difficulty of arriving at a diagnosis, any new method that promises to be of assistance would eagerly be adopted" still holds good.—*Karl Kornblum.*

Podesta, V. Contributo all studio dei vizi di posizione e di grandezza del cieco e del colon. (Abnormalities in the position and size of the cecum and colon.) *Arch. di radiol.*, Sept.-Oct., 1929, *5*, 853–872.

There are many abdominal cases with vague symptoms that are very hard to diagnose. There is pain, more or less localized or diffuse, meteorism, stubborn constipation with periods of mucomembranous diarrhea, gastric disturbances which sometimes suggest organic lesions of the stomach, loss of strength and weight, hypochondriacal nervous symptoms, etc. The author says that roentgen examination of the digestive tract has shown that many of these syndromes are caused by abnormalities in the position, size and length of the large intestine due to arrest of development of the colon at various stages of embryonic life. Such abnormalities cannot be diagnosed in any other way than by roentgen examination.

He describes and gives illustrative roentgenograms of 2 cases which he has seen recently. In the first one, in a woman of forty-seven, there was a partial situs inversus of the abdominal viscera from an arrest of rotation of the colon in embryonic life. The whole of the colon was affected by the dolichomacrocolia, particularly the transverse colon, but the ascending colon and sigmoid were also long. The cecum was on the left and low down in the true pelvis. In the second case, in a man of fifty-one, the cecum was enormously dilated and high up just beneath the liver. The cecum was almost parallel to the transverse colon which was short, while the descending colon was very long. The sigmoid was on the right beneath the cecum and was relatively small and short. There was marked retardation in the emptying time of the stomach and of the enlarged cecum.—*Audrey G. Morgan.*

Weber, H. M. Factors of error in the roentgenologic diagnosis of diseases of the colon. *Radiology*, May, 1930, *14*, 460–466.

The author prefers the opaque enema for examination of the colon. Since fecal material in the bowel may not only make satisfactory study of the colon impossible but also produces defects resembling those of organic disease, he routinely requires the patient to take 2 ounces of castor oil the evening before examination and cleanse the bowel with a soapy enema next morning. His examination is roentgenoscopic and the abdomen is freely palpated to separate superimposed loops of bowel in order that all parts of the colon may be studied. If the patient has undue difficulty in retaining

the enema, or if spasm is marked and perplexing, he administers 60 drops of tincture of belladonna, divided into three equal doses, two of which are given two hours apart in the evening and the remaining dose next morning an hour before re-examination. The filling defect is by far the most common roentgen manifestation of organic disease of the colon, and is produced by cancer, diverticulitis, tuberculosis, chronic ulcerative colitis, extrinsic lesions, organic stricture, and syphilis in about that order of frequency. To distinguish between these diseases the examiner must consider the site and configuration of the defect, the presence or absence of a palpable mass, and the fixation or mobility of the affected portion of the bowel.—*J. D. Camp.*

AUCHINCLOSS, HUGH. A clinical study of calcified nodes in the mesentery. *Ann. Surg.*, March, 1930, *91*, 401–415.

As the title indicates, this paper is in the main a clinical study of a symptom-complex that is caused by tuberculous infection of mesenteric lymph glands. Calcified mesenteric nodes represent healed or partially healed foci of infection. Adequate emptying of the colon previous to roentgen study is emphasized, as well as the desirability of making several films, prone, supine and lateral.

These lesions may cause symptoms due: (1) to adhesion bands and contractions; (2) to other intestinal or lymph node lesions of a like nature but still active, not scarred nor calcified, and (3) to the presence of the node alone.

When calcified nodes are found, it is frequently possible to get a history of the actual infection, a period in childhood when the patient was definitely below par, usually underweight, always needing a tonic, never quite cured of anything and always convalescing slowly.

Acute abdominal symptoms and signs, without leucocytosis or increased polymorphonuclear count should always arouse suspicion of tuberculous mesenteric node infection, whether calcified or not, especially if the pulse and temperature are low.—*P. A. Bishop.*

SCHWARTZ, JOSEPH. Suppuration in the subphrenic region, with special reference to primary idiopathic liver and subphrenic abscess. *Arch. Surg.*, Feb., 1930, *20*, 317–332.

Liver and subdiaphragmatic abscesses, in 95 per cent of cases, are said to be due to lesions of the stomach, appendix, biliary tract and duodenum, in the order named. Another type occurs without demonstrable foci and is called the primary or idiopathic type. Eight such cases are reported by the author.

The condition is usually diagnosed late, after it is well established. It is most frequently mistaken for pneumonia or pleurisy with effusion. These thoracic changes are believed to be due to elevation of the diaphragm with resulting compression of the lung and promptly disappear after the abscess is drained.

Roentgenograms and fluoroscopy are important aids in diagnosis. It is strongly urged that these examinations be repeated frequently whenever such a lesion is believed to be developing. The roentgen features are: (*a*) an elevation of the diaphragm with restricted excursion; (*b*) the presence of air, with or without a fluid level, beneath the diaphragm, and (*c*) intrathoracic changes leading to a diagnosis of pneumonia and pleural effusion.

The mortality rate is high because of late or non-recognition and its association with other extensive lesions.—*P. A. Bishop.*

SKELETAL SYSTEM

LOCKWOOD, I. H., JOHNSON, E. T., and NARR, F. C. Hodgkin's disease with involvement of bone and skeletal muscles. *Radiology*, May, 1930, *14*, 445–452.

The authors present a case of Hodgkin's disease in a boy aged fifteen, whose first symptom was shingles and whose chief complaint on admission was backache. At this time a roentgenogram revealed definite bone destruction in the first four lumbar vertebrae, the ilium and the femurs, although six months previously no definite changes in these structures were demonstrable. Biopsy established the diagnosis of Hodgkin's disease. The course was one of increasing severity with bone destruction of the dorsal and lumbar vertebrae, ilium and femurs, and involvement of all lymph nodes, lungs, liver and skeletal muscles. The writers think that shingles has too frequently been reported in Hodgkin's disease to be without significance.—*J. D. Camp.*

Bársony, Theodor, and Koppenstein, Ernst. Calcinosis intervertebralis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, *41*, 211–239.

The author presents 8 cases of intervertebral calcifications of his own and 9 cases collected from the literature. On the basis of a study of these cases the following conclusions are drawn: Intervertebral calcifications may involve part or the entire nucleus pulposus and may extend to the annulus fibrosus. According to the site and extent of the calcification a very manifold roentgen appearance is obtained. The incidence of the roentgen rays as well as the position of the patient may lead to further distortions, the incidence of the rays influencing even the homogeneity of the calcium shadows. Thus the more eccentric the direction of the central ray, the less homogeneous the roentgen image of the calcified area.

The author observed that when the calcification extended from the nucleus pulposus to the annulus fibrosus a small peripheral zone always remained free of calcium deposit. This zone he called the calcium resistant zone, while the central zone was named the zone of calcium affinity. In many instances there was evidence of calcium deposits also on the edge of the intervertebral discs. This he called the peripheral zone of calcium affinity.

Central calcifications were observed between the fifth dorsal and first lumbar segments, while the peripheral calcifications occurred on the entire spine.

The central calcifications of the intervertebral discs do not form a typical clinical picture. Sometimes no symptoms whatever are present and at other times the symptomatology is very severe (pain, lumbago, rheumatism, etc.). The therapy is symptomatic and is the same as for any spondylosis.—*T. Leucutia.*

Friedrich, H. Über Lymphogranulomatose (Hodgkin) des Knochens. (On lymphogranulomatosis (Hodgkin) of bones.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, *41*, 206–211.

The extension of Hodgkin's disease to the bony structures is very rare. The few cases recorded in the literature are briefly reviewed.

The author describes in detail a case, that of a boy aged twenty, in which the Hodgkin's disease had extended to both lower jaws. The roentgenograms presented an irregular thickening with numerous areas of rarefaction in the central and with a rather marked increase in the density in the marginal portions of the bone. The appearance was very similar to that of osteitis fibrosa (Paget).

The application of roentgen therapy produced a local healing. Two years later the patient died from a general extension of the disease.—*T. Leucutia.*

Kienböck, R. Über die sogenannte "ostitis fibrosa" ("Osteodystrophia fibrosa"). (On the so-called "osteitis fibrosa"—"osteodystrophia fibrosa".) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 34–38.

1. Osteitis deformans (Paget's disease). This consists in an atrophic-hypertrophic dysplasia of the bony structures, roentgenologically characterized by increased density of the bones of the skeleton.

2. Osteitis fibrosa cystica generalisata (Recklinghausen). This condition is characterized by atrophic dysplasia alone and is localized to parts of the skeleton or the entire skeleton. Roentgenologically it appears in the form of areas of rarefaction.

There is a great dissension with regard to the etiology of these two conditions. The dualists believe that osteitis deformans (Paget) and osteitis fibrosa cystica generalisata (Recklinghausen) are two distinct entities, while the unitarians are of the opinion that they are manifestations of one and the same disease.

The author, on the basis of a study of a large number of cases, favors the dualistic theory, and in the near future will present a series of articles in support of this theory.—*T. Leucutia.*

Weiss, Konrad. Die Osteoporosis circumscripta Schüller—eine seltene, aber typische Erscheinungsform der Pagetschen Knochenerkrankung. (Osteoporosis circumscripta (Schüller)—a rare but typical form of Paget's disease.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, *41*, 8–16.

Schüller in 1929 described a form of osteoporosis of the skull, the so-called "osteoporosis circumscripta," which was characterized by areas of rarefaction of both tables of the skull without evidence of alterations in the rest of the skeleton. Schüller assumed that the

condition was a distinct entity although he admitted that a similarity with Paget's disease existed.

The author was able to observe osteoporosis circumscripta of the skull in 2 cases (a man sixty-six years of age and a woman of forty-eight), in which in addition to the changes in the skull there was evidence of typical Paget's disease of several bones of the skeleton. From this he deduced that the osteoporosis circumscripta as described by Schüller does not constitute a separate entity but that it is merely a manifestation of Paget's disease.—*T. Leucutia.*

MADLENER, M. J., and PAAS, H. R. Über röntgenologisch feststellbare Deformierungen der Kniescheibe nach Patellarfrakturen. (On the roentgenologically demonstrated deformities of the knee cap following fractures of the patella.) *Fortschr a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, *41*, 38–43.

Sixty-four cases of patellar fractures were observed between 1919 and 1928, of which 31 were followed up. The control examinations consisted in the taking of roentgenograms in the lateral, posteroanterior and axial direction.

It was found that the late deformities of healed patellar fractures (whether they were treated conservatively or by wire suturing) consisted: (1) in elongation of the patella in the sagittal axis due to pull of the muscles during the actual duration of the callus formation; (2) in a slight increase of the transverse diameter of the patella; (3) in a roughening of the anterior and posterior surfaces of the patella, and (4) in a deposit of calcium in the soft structures around the patella (quadriceps tendon, ligamentum patellae, etc.).

The author calls attention to the fact that the roentgen examination in the axial direction is of great aid in diagnosing imperfectly healed longitudinal fractures of the patella.—*T. Leucutia.*

JUNGHANNS, HERBERT. Die Spondylolisthese im Röntgenbild. (The roentgen picture of spondylolisthesis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, *41*, 239–245.

On the basis of a study of the anatomical specimens of 30 cases, the author expresses the opinion that spondylolisthesis is the result of a congenital anomaly of the articulation between the fourth and fifth lumbar vertebrae. This anomaly consists in a slight gaping of the intervertebral processes which later due to repeated trauma and because of the lessened resistance gradually increases, leading to a slipping of the body of the fourth lumbar vertebra over that of the fifth. During this process the articular and spinous processes maintain their normal position. The slipping of the body of the fourth lumbar vertebra leads to a number of secondary changes such as narrowing of the intervertebral space, S-shaped deformity of the intervertebral disc, thickening of the adjacent portions of the vertebral bodies, formation of osteophytic deposits and increase of the lumbosacral angulation.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

ADLER, KARL. Die Beeinflussung des Gewebsstoffwechsels durch Röntgen- und Radiumbestrahlung. (Effect of roentgen and radium radiation on tissue metabolism.) *Strahlentherapie*, 1929, *34*, 587–588.

In these experiments oxidation and lactic acid formation under aerobic and anaerobic conditions were determined. A series of sexually mature rats were given an irradiation of 600 R on the testicles and metabolism determined, after having found the normal values on unirradiated rats. There was no change in cell metabolism immediately after the irradiation. So the rays do not act primarily on cell metabolism. The first changes began twenty-four hours after irradiation and increased with time. Tissue respiration decreased and aerobic and anaerobic glycolysis rose to double their normal value. The highest values were reached on the 34th to 36th day after the irradiation. This approximates the type of metabolism of maligant tumors. After the 40th day the figures for glycolysis fell to below normal. Histological examination showed degenerative changes in the nuclei of the semen-producing cells. After the 40th day the degenerated cells were cast off and the lumina of the tubules of the testicles were partially filled with proliferated Sertoli cells. About this time aerobic glycolysis fell almost to zero and anaerobic glycolysis to less than the normal value for the non-irradiated testicle.

A second series of animals were irradiated with 2500 R. The changes in metabolism were the same in nature but took place more rapidly. A third series were irradiated with 2400 mg-hr. of radium. The changes were the same except that respiration decreased even more rapidly and intensely and glycolysis did not reach the same height as after roentgen irradiation. Serum was also irradiated and showed the same changes in metabolism. These changes in metabolism approximating the type of metabolism of malignant tumors explain why carcinoma may develop after chronic injury with small doses of roentgen and radium rays.—*Audrey G. Morgan.*

Freund, L. Studien über den Ablauf von Radiumreaktionen auf der gesunden und kranken menschlichen Haut. (The course of radium reactions on the normal and diseased human skin.) *Strahlentherapie*, 1929, *34*, 767–786.

The experiments were made with capsule-shaped radium carriers in which 60.4 mg. radium-barium sulphate was distributed over a round surface with an area of 3.1 sq. cm. The layer of radium was covered with a mica window 0.1 mm. thick and that with a silver window 0.2 mm. thick, made as nearly gas-tight as possible. The radium content was 17.75 mg. Curves and tables are given showing the details of the results.

When an erythema dose was applied for forty minutes there was a preliminary wave of redness beginning after a short latent period and rising to about the 5th degree of redness and then falling rapidly. From the 14th day it began to rise to the chief reaction which reached its maximum on the 57th day which was considerably higher than that of the preliminary reaction (10th degree of redness). It quickly fell from this peak and reached its lowest point (1st degree of redness) on the 72d day, then rose a little and gradually disappeared. Between the preliminary and chief reactions there was a third wave. There are differences in different individuals with regard to the beginning of the rise, the length of the waves, the time at which they reach their maximum and the height of the maximum. There are such differences not only in different individuals but in the same individual at different times and on different parts of the body.

When the forty minute dose was divided into four ten minute doses the curve was more complicated; it may be said roughly to correspond to four curves like that described above.

The radium was then applied to cases of psoriasis to try to determine the relation between the erythema and the therapeutic effect. The therapeutic effect was found to be proportional to the erythema but there was no relation between the pigmentation curve and the course of the disease.—*Audrey G. Morgan.*

May, E. A. Roentgen therapy in acute inflammatory conditions. *Radiology*, April, 1930, *14*, 411–415.

Roentgen treatment of acute inflammatory conditions is of great help to surgery and also to more conservative methods, in the opinion of the author. It cannot replace old methods but is a very helpful adjunct to them. It not only alleviates pain, but also affects the entire process of inflammation. It should not be undertaken without proper surgical supervision. Its beneficial action is both local and general. The local effects are hyperemia, dilatation of the blood vessels, increased circulation of the lymph, and other local immunizing processes. In general, it tends to increase the specific and non-specific forces of resistance. The optional dose of radiation lies between 130 and 300 r-units on the skin over the inflamed area, using heavy filtration and high voltage. Two hundred thirty-five cases, comprising furuncle, osteomyelitis, paronychia, pneumonia, and various other acute inflammations, were subjected to roentgen treatment by May, and benefit resulted in 81.3 per cent.—*J. D. Camp.*

Tamiya, Ch., and Koyama, M. Über röntgenologische Behandlung der Verbrennung und Verätzung der menschlichen Haut. (Roentgen treatment of burns and cauterization of the human skin.) *Strahlentherapie*, 1929, *34*, 808–812.

The authors treated 13 cases of burns and 2 of cauterization with roentgen rays. The burns were mostly of the first and second degree, one of the first degree. Most of the cases were sent after other methods had failed. Before the irradiations the salves that had been used were washed away, the area cleaned and disinfected with alcohol or sublimate. The torn skin was drawn over the exposed corium. It was not necessary to open even large vesicles, as is

done generally; they were left untouched or at most punctured aseptically to let out excessive contents. It is important not to remove them and expose the corium. The dose was 1 to 3 H (about 12 to 36 per cent of a skin erythema dose), filtered through 1 mm. Al, with 4.5 ma. and 80 kv. With a focus-skin distance of 30 cm. the desired dose was given in one minute eighteen seconds to three minutes fifty-four seconds. The burned places were covered with aseptic cotton fastened on with gauze and adhesive plaster.

The results were excellent. There was rapid decrease of the pain which began a few hours or sometimes immediately after the irradiation. There was rapid decrease of the redness and swelling and drying of the exposed corium and rapid absorption of the contents of the vesicles. Invasion of bacteria was prevented by rapid cornification of the exposed layer of corium. The method itself has the advantage that it is not necessary to remove the vesicles or change dressings often. The method will probably shorten the time required for the healing of burns.—*Audrey G. Morgan.*

Ewing, James. Factors determining radioresistance in tumors. *Radiology*, March, 1930, *14*, 186–190.

The author holds that the resistance of tumors to irradiation may be due to the adult character of the stroma; this form of resistance is observed in many types of sarcoma of bone, nerve and cartilage. The adult characters of epithelial cells and the substantial blood supply render adenomas and papillomas radioresistant. Carcinomas are resistant in inverse ratio to the degree of anaplasia and in direct proportion to the amount of desmoplastic reaction which they excite. In mixed tumors in which one element is sensitive and the other resistant, the malignant portion may be sterilized, although the tumor does not diminish in size and a false impression of radioresistance may be gained; this is exemplified in mixed tumors of the testis and teratomatous tumors in the abdomen, kidney or sacral region. A special instance of spurious resistance is seen in very vascular giant cell tumors, which are well designated as benign bone aneurysms. The nature of the tumor bed in favoring or retarding response to treatment; the high resistance of malignant tumors invading bone or cartilage is well known. Infected tumors which are the seat of exudative inflammation do not react well to treatment, but a full explanation of this fact is hard to find.—*J. D. Camp.*

Hirsch, Henri. Über echte Organotherapie mittels der Hipocide, insbesondere zur therapeutischen Beeinflussung der Carcinom-Kachexie. (Organotherapy with hipocids, particularly in carcinoma cachexia.) *Strahlentherapie*, 1929, *34*, 381–402.

In attempts to increase the action of roentgen rays the author used iodized wax (dextrocid). He decided that this preparation which was so good for sensitizing purposes could also be used for organotherapy if it could be combined with organ extracts. He succeeded in storing the organ extracts in the dextrocid by a method of dialysis and called these preparations hipocids. He made them with extracts of various organs. They can be kept indefinitely because the iodine sterilizes them. He first tested the liver hipocid in Biermer's anemia and found that it brought about great improvement in the blood picture. He then used it in various pregnancy toxicoses supposed to be due to insufficiency of the liver with equally good effect. As disturbed liver metabolism seems to be the cause of cancer cachexia he also used liver hipocid on this condition; later he prepared a triple hipocid of liver, pancreas and spleen and used it in cancer cachexia. At first to increase calcium metabolism he used an extract of parathyroid but later substituted administration of calcium for this. Calcium changes the acid medium in which cancer seems to thrive best in the direction of alkalinization. He gave roentgen dextrocid treatment and between the series of irradiations hipocid treatment by mouth. He greatly improved his results in the treatment of malignant tumors in this way. His material was the worst possible as the patients were in an advanced stage of cachexia with recurrences and metastases. He has now treated 63 cases with hipocid from 1926 to 1928. After roentgen-dextrocid treatment and within four to seven months after the beginning of hipocid treatment and generally within fifty to sixty days, the hemoglobin content of the blood rose at least 15 per cent, the erythrocytes increased on an average of 1.3 million and the leucocytes by about 5600. The weight curve

rose with the improvement in the general condition and blood picture. A gain of 10 pounds in a short time was not unusual. From the middle of 1926 to the middle of 1927, 20 cases of carcinoma were treated. All had been operated on and were sent for treatment for recurrence or metastasis. Seven of these patients died in the course of 1928; the other 13 are alive and continuing to improve. From the middle of 1927 to the middle of 1928, 43 cases were treated; 14 of these patients have died, the others are alive. Among the total of 63 cases 21 patients have died; 42 were living in June, 1929. Of course definite judgment cannot be passed on the cases until after five years but the condition of the patients is such that it justifies extensive use of the method.—*Audrey G. Morgan.*

Seulberger, P., Schmidt, W., and Kröning, F. Röntgenologische Untersuchungen an Carcinomen. I. Cytologie und Histologie der Tumoren nach mehrfacher Bestrahlung. (Roentgen studies of carcinoma. I. Cytology and histology after several irradiations.) *Strahlentherapie*, 1929, *34*, 247–272.

In a former article the authors reported the appearance of the mitoses and chromosomes in human tumors before and after irradiation with a single large dose of roentgen rays. In this article they report the results after single and multiple irradiations with small doses. They describe the details in regard to normal mitoses, injured mitoses, pycnoses, autolysis, cornification, edema, hyperemia, round cells, leucocytes and lymphocytes, between the tumor cells, and the mobilization and proliferation of undifferentiated young connective tissue in 6 cases. In 2 cases 20 and 50 per cent of a skin erythema dose was given once. In the third case $33\frac{1}{3}$ per cent was given and after five days 50 per cent. In the fourth case $33\frac{1}{3}$ per cent was given 4 times with intervals between the doses of 3, 4 and 9 days. In the 5th case $33\frac{1}{3}$ per cent was given 5 times, with intervals of 3, 10, 11, 5 and 11 days. In the 6th case two series of irradiations were given. In the first series $33\frac{1}{3}$ per cent was given five times with intervals of 2, 2, 3 and 4 days and in the second series $33\frac{1}{3}$ per cent was given four times with intervals of 4, 10 and 7 days, then after 9 days 50 per cent and after 13 more days 60 per cent. Sometimes by regulating the dosage by the appearance of the mitoses with the histological picture of the tumor results can be attained with 20 to 50 per cent of a skin erythema dose as good as are ordinarily attained by 80–100 per cent. The reaction of the mitoses is of course much more sensitive than the clinical reaction. The dose and rhythm of the irradiation are not yet well enough worked out so that deep carcinomas can always be cured, but the method is hopeful.—*Audrey G. Morgan.*

Rodenbaugh, Frederick Hase. Treatment of malignant tumors of the eye and orbit by radiation. *Radiology*, March, 1930, *14*, 309–315.

The present status of radiation therapy for tumors of the orbit is summarized by the author as follows: In tumors of the conjunctiva and cornea, radiation, preferably from radium, with a maximum conservation of normal tissue looking to clinical cure, should be given first consideration. In basal cell epitheliomas of the adnexa, as elsewhere in the body, the clinical cures are satisfactory and radiation is superior to other methods of treatment. The angiomas, lymphomas, sarcomas, granulomas, fibromas, and nevi, occurring as primary tumors, are susceptible to radiation, their response varying with their histological structure. The numerous metastatic tumors will vary in their response to radiation, their susceptibility depending on their histological structure. Types of localized tumors of the iris or ciliary body, of doubtful nature, have been favorably influenced by radiation, and such treatment should receive consideration before resorting to radical surgical methods. It is of greater importance to secure clinical regression of a new-growth, with conservation of essential structures, than to have a histological study with loss of function.—*J. D. Camp.*

Quick, Douglas. Treatment of malignant growths of the nasal accessory sinuses and nasopharynx. *Radiology*, March, 1930, *14*, 191–196.

The author states that radium and roentgen rays are of value in treating this group of cases, but, except in palliative procedures, must be used in conjunction with surgery. Radium and roentgen rays may be depended on to eradicate the tumor tissue if applied ac-

curately and uniformly throughout the growth in sufficient dosage. Surgery must be employed to provide exposure for radium application and adequate drainage. The anatomical relations are such that infection is a much greater menace here than in new-growths in most other locations.—*J. D. Camp.*

Schulte, G. Ein seit 6 Jahren nur durch Röntgenbestrahlungen geheiltes Zungencarcinom. (A case of carcinoma of the tongue cured for six years by roentgen treatment alone.) *Strahlentherapie*, 1929, *34*, 541–543.

This case is reported because there has not been such long freedom from recurrence (more than five years) in any other case of carcinoma of the tongue treated with roentgen rays alone. The patient was a man of fifty-two who came for treatment in February, 1923, with a carcinoma of the whole base of the tongue extending to the pharynx and glosso-epiglottidean ligament and far forward. There was little hope from operation as there were gland metastases. Irradiation was given with Jüngling's radioplastin method. The whole of the mouth and gland region are irradiated homogeneously on three successive days with 100 per cent of the cacinoma dose, the larynx and salivary glands being protected as far as possible. There was an intense primary reaction. For a time the patient had dyspnea and could not swallow. Ten days after the irradiation improvement began. A piece of the tumor was cast off; it showed carcinoma cells and in places necrosis and leucocyte infiltration. Four weeks after the irradiation the tumor had disappeared and the patient was free of symptoms. There was complete epilation except for a small part over the larynx that had been covered and the patient's mouth was dry. Five months later the patient came back with a tumor the size of a small hen's egg over the left sternoclavicular joint, firmly adherent to the underlying tissues. On both sides of the neck along the sternocleidomastoid there was a chain of glands the size of hazelnuts to the size of dove's eggs. General condition poor. The tumor was extirpated as far as possible under general anesthesia. Microscopic examination showed carcinoma. The field of operation and the glands of the neck were irradiated as before with a full carcinoma dose. Two months later the glands had disappeared. A year later another irradiation of the left sternoclavicular joint was given as it was slightly swollen. Since then the patient has been absolutely well and able to work. The dryness of the mouth persisted for about a year and then gradually disappeared. His beard also grew again gradually. There is a scar on the left border of the tongue but it interferes very little with the movements of the tongue. His speech is clear and there are no swollengl ands.—*Audrey G. Morgan.*